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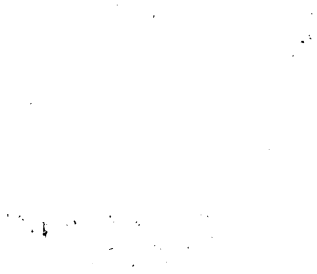

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SUBMARINES AND SEA POWER

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SUBMARINES AND SEA POWER

BY

CHARLES DOMVILLE-FIFE

AUTHOR OF
"SUBMARINES OF THE WORLD'S NAVIES"
"THE SUBMARINE IN WAR"
"SUBMARINE ENGINEERING OF TO-DAY"
"NAVAL STRATEGY" ETC.

NEW YORK
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PREFACE

SUBMARINES and Sea Power is, in framework, a statement of principles, supported by examples from modern war, showing the uses of submarines in naval operations, and the changes produced by their evolution in the old theory of "Sea Power," the application of naval strategy and tactics, and the national life of maritime nations. The thesis advanced, which has been based on the three great naval wars of modern times, the American Civil War, the Russo-Japanese War, and the Great European War of 1914 to 1919, in which the submarine, the mine, and the torpedo have played an ever increasing part, is not a mere superficial review of recent events, but embodies the lessons—vital to sea empires—adduced from careful study extending over the past fourteen years of rapid development, culminating in the stern trial of war, combined with practical experience gained during three years in command of anti-submarine craft and on the staff of H.M. School of Submarine Mining.

To those whose first attitude is one of hostile criticism I would ask that the book may be read to the end before any definite opinion is formed, assuring them that no conclusions have been arrived at

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without careful thought and consultation of, and with, many authorities. Every effort has been made to prevent any bias for or against the submarine arms from warping fair judgment, and if there are any inaccuracies, then I would crave indulgence on the plea that modern war has made chaos in the ranks of the standards of the past, shaking to their very foundations the old theories of sea power, and rendering obsolete and useless hitherto accepted *facts* and *principles.*

The great and far-reaching victory achieved by the Allied arms, and the successful creation of a League of Nations—bound by covenant to enforce a reign of peace in a war-weary world—may appear to make the present an inopportune moment for the publication of a treatise on the theory of future naval war. Yet there have been great victories, leagues, alliances, courts of arbitration, and covenants, from the dawn of history, many of which, in the fulness of time, have been the seeds of the wars they were created to avert. Therefore, while steadfastly and even hopefully looking towards the vivid dawn of a new era, it is well that the eyes of nations who live by the sea should not be blinded by the unprecedented brilliance of the early light, remembering, while passing through a world in transformation, the old and proven axiom which calls for strength to avert war and denounces weakness as courting it.

CHARLES DOMVILLE-FIFE.

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INTRODUCTION

IN the fog of war which has enveloped the whole of Europe for the past four years the great lessons of the future have been learned. Among them is the influence of submarines and mines on naval strategy, tactics, and sea power. As far back as 1911 Admiral Mahan expressed the opinion that the greater range of the submarine and torpedo would affect the application of naval strategy, but in exactly what manner and to what extent it was not possible to determine until recent developments combined with experience in modern fighting enabled the practical value of the submarine, and its scope and limitations under a variety of conditions in the actual stress of war, to be accurately estimated.

Napoleon's dictum that *war is a business of positions* aptly indicates one of the main advantages accruing from the use of submarines. These underwater warships can reach almost any desired point in the theatre of operations, although they may have to pass under a zone alive with hostile ships. This, as will easily be seen, has its effect on the possible lines of communication of a surface fleet, the transport of troops, trade-routes, and the security of temporary bases. For examples of this we have only to recall the depredations of German submarines in the Irish Sea, St. George's Channel, and the English

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Channel, after passing, on their way out from Heligoland, British patrol flotillas in the North Sea and elsewhere; the torpedoing of the German battleship *Moltke* in the Baltic by a British submarine which had passed under the defences of the Belt; and the destruction of Turkish transports in the Sea of Marmora by British submarines which had passed through the mine defences in the Narrows of the Dardanelles. Reflect here on the fate of Constantinople had these submarines carried the heavy guns (9-inch and 12-inch) now being installed on underwater fighting ships of large size, such as the M1 of the British Navy. The Turkish defences in the Narrows held back the allied surface fleets and armies for many months, but could not stop the submarines. Scarborough was bombarded by German cruisers which eluded the vigilance of the British patrols, but Whitehaven, on the coast of England farthest removed from the theatre of operations, was shelled by a U-boat with impunity. The damage done was slight, but the two guns then installed on submarines were only 28-pounders. What the effect of this bombardment would have been under more recent conditions, with the submarine's 12-inch guns, can be easily realised. This foreshadows the danger which will threaten all coast towns within range of hostile submarines in future naval warfare, notwithstanding the vigilance of patrol flotillas. The transportation of troops by sea has been rendered a far more difficult and dangerous operation by the employment and range of submarines. The sinking of a British transport in the Gulf of Saros by a hostile submarine is an illustration of the ever-present under-water menace. This transport had passed safely out of the danger zone in home

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waters, and was actually within a short distance of the allied fleet at the entrance to the Dardanelles when death and destruction came swift and silently, resulting in the loss of many hundreds of men, reinforcements for the army of Gallipoli. In this can be seen the influence of the submarine on certain kinds of land campaigns.

Turning from the influence of these vessels on the conduct of war to their effect on national life in wartime, we find in England during 1914 a rise in the rates for marine insurance, the destruction of hundreds of merchant ships by a *few* submarines in less than two years, and, as an omen of the future, Lord Selborne, the British Minister for Agriculture, saying, in August 1915, that unless some naval answer to the submarine was forthcoming he was of opinion that Great Britain would have to revise her agricultural and economic position after the war in the light of her submarine experiences. Commenting on this speech, the leading London dailies stated: "The submarine experience, as Lord Selborne says, must be the motive for the reform of the whole agricultural and economic policy of the food production at home after the war." "When the civilian population's food is brought below the margin of necessity there follow panic and riots. . . . But we must never again, in our indolence and over-confidence, run such fearful risks." "In a war of the future the submarine may be a much more perfect and deadly instrument. The type may grow into an almost indestructible underwater Dreadnought, or an enemy might build hundreds where he had built tens. It is not mere fantasy to suppose that the Germans would not have hesitated to aim at building and manning a thousand sub-

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marines had they possessed as much naval genius as they did military prescience."

In connection with the food supply of Great Britain during the German submarine blockade the following facts, taken from a later chapter in which this subject is treated *in extenso*, may be of interest here. The length of coast-line over which the blockade may be said to have extended was approximately 1500 miles, and the number of ports on that coast-line was forty, of which only ten need be considered as food-inlets. The transatlantic routes were the danger lines to England. Germany at the commencement of the blockade possessed about 150 submarines, only about 120 of which were capable of remaining at sea for a sufficiently long period to effectively take part in the blockade. The distance out and home to Heligoland was about 1800 miles, and the total range of these vessels was about 4000 miles. The average time occupied by German submarines in getting from their base at Heligoland to the transatlantic trade-routes and back was fourteen days. Allowing for a month at sea, only about fourteen days were actually spent on the trade-routes. Relays of submarines thus became necessary in order to maintain a more or less continual vigilance. This divided the blockading flotilla into two parts, one an active patrol and the other either replenishing stores or going to and from the base. This arrangement did not, however, allow for vessels temporarily damaged or totally destroyed, which rapidly reduced the number by 50 per cent., leaving only thirty vessels in the active and thirty in the reserve patrol. The result of this ineffective blockade was a loss of seven merchantmen during the first week out of a total of

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1400 vessels entering and clearing from the ports of the United Kingdom. The average loss taken over a period of three months was about 2 per cent., or 300 vessels out of 15,000 in a year, with an average tonnage of 400,000 against 22,000,000.

Although this was not a startling success for the German blockade as a fact it was a success *in theory*, for it must be considered what the effect would have been had Germany been able to maintain not merely thirty submarines on the transatlantic food-routes, but, say, 500 vessels, larger, faster, and more heavily armed, and capable of keeping the sea in all weathers for periods of three months. The result could only have been a serious shortage of food in the United Kingdom. It is of interest for all nations not self-supporting where food or munitions of war are concerned, with fewer ports or a shorter coast-line, whose mercantile marine is less numerous, or whose seacoast towns are open to bombardment by the larger guns now installed on submarines, to consider carefully the effect of the super-submarine on future naval warfare. Even if the loss of submarines be reckoned at 50 per cent. per annum when opposed by the world's greatest navy supplemented by many hundreds of armed auxiliaries exclusively used for submarine and mine destroying, it does not in any way lessen the value of under-water craft, but only increases the number required for active operations and to be held in reserve.

If a true appreciation of the influence of under-water fighting on national life in time of war is desired, attention must also be directed to the growing part played by explosive submarine mines. A statement by the British Official Press Bureau, issued on

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23rd August 1914, gives some idea of the danger caused by these weapons in zones of war not only to belligerents, but also to neutrals. It must be borne in mind that the loss of vessels due to mines laid by the Germans in the North Sea during the first six months of the Great War would have been far greater had England not employed over one thousand vessels in mine-sweeping operations in this one zone. The following is the statement by the Press Bureau:

"The Admiralty wish to draw attention to their previous warnings to neutrals of the danger of traversing the North Sea. The Germans are continuing their practice of laying mines indiscriminately upon the ordinary trade-routes. These mines are not laid in connection with any definite military scheme, such as the closing of a military port, or as a distinct operation against a fighting fleet, but appear to be scattered on the chance of catching individual British war or merchant vessels.

"In consequence of this policy neutral ships, no matter what their destination, are exposed to the gravest dangers. Two Danish vessels, the steamship *Maryland* and the steamship *Broberg*, have within the last twenty-four hours been destroyed by these deadly engines in the North Sea while travelling on the ordinary routes at a considerable distance from the British coast. In addition to this, it is reported that two Dutch steamers, clearing from Swedish ports, were yesterday blown up by mines in the Baltic. In these circumstances the Admiralty desire to impress not only upon British but on neutral shipping the vital importance of touching at British ports before entering the North Sea, in

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order to ascertain, according to the latest information, the routes and channels which the Admiralty are keeping swept, and along which these dangers to neutrals are reduced so far as possible.

"The Admiralty, while reserving to themselves the utmost liberty of retaliatory action against this new form of warfare, announce that they have not so far laid any mines during the present war and that they are endeavouring to keep the sea-routes open for peaceful commerce."

If the Russo-Japanese War was the first to fully demonstrate the value of the explosive mine, the great European conflict has certainly brought this weapon to the forefront in the rapidly growing science of submarine warfare. During the first few weeks of the naval fighting several warships, H.M.S. *Amphion* and others, and many merchant vessels representing millions of pounds sterling were destroyed by these weapons. Had it not been for the foresight of the British Admiralty in providing a very large fleet of mine-sweepers, aided by seaplanes, there can be no doubt but that the shipping of all countries—neutrals and belligerents alike—would have suffered far greater losses. During the four and a quarter years of warfare, about 300 merchant ships and 200 British mine-sweepers were either destroyed or badly damaged by these invisible weapons.

The indiscriminate scattering of mines by submarine layers across the trade-routes, as carried on by Germany immediately on the outbreak of war, and almost before any of the ships at sea belonging to neutral countries could be warned to avoid the zone of operations, has never before been so ruth-

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lessly resorted to by a great civilised power, and raises points in the laws of war which will receive attention in later pages.

In my book, *The Submarine in War*, written for the *Daily Telegraph* series, it was pointed out that the hour of the torpedo came with the perfection of the submarine. All the conditions of an ideal torpedo-boat were fulfilled—*invisibility*, rendering daylight attacks possible; *almost perfect immunity from gun-fire*, enabling the torpedo to be discharged at closer range; *submerged discharge*, removing the likelihood of the weapon being exploded by accurate gun-fire before being discharged; *speed on the surface*, enabling the "carrying" vessel to manœuvre for position; *moderate speed when submerged*, enabling an attack to be made under all reasonable tactical conditions; and *comparatively large displacement*, giving good cruising qualities, wide range of action, and enabling a large number of torpedoes and tubes to be carried.[1]

The submarine torpedo has become one of the principal naval arms. Not only does it supply the chief offensive power of the submarine, the torpedo-boat, and the destroyer, but it is also carried as a separate arm by almost every warship afloat. At the beginning of hostilities the naval powers engaged owned considerably over 80,000 of these weapons, and one factory in England alone can make them at the rate of two a day. During the first few weeks of the Great War the torpedo was responsible for the sinking of warships to the value of over two millions sterling, and in four and a half years it was the means of destroying some eighty allied warships, both large

[1] *The Submarine in War*, p. 167.

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and small, and over 1000 merchantmen. Had the German fleet been on the high seas, instead of in harbour and protected from torpedo raids by carefully prepared submarine defences, there is little doubt but that several more hostile ships would have been sunk by this weapon. The fact that at first the British light cruisers suffered rather heavily—though in total loss of ships and men less than the German Navy—does not point to any advantage derived either from the type of torpedo used or from skill in this mode of warfare possessed by the Germans, but clearly to the timidity of the German main fleet, which was at the very beginning of hostilities withdrawn from the zone of war and placed behind fortifications, where it was safe from torpedo attack. The British fleet, true to the policy of "attack and not defence," began operations the moment war was declared, with results so brilliantly successful, and of such far-reaching and world-wide importance, that enumeration is well-nigh impossible. But while all these operations were in progress the British fleet was more or less exposed to torpedo attack by any hostile submarines which might succeed in getting past the cordon of protecting destroyers, while the German fleet was safe, but ignominiously impotent. That the naval losses of Great Britain, with all her fleets at sea, were not far greater was in itself a victory of the greatest magnitude.

This brings us to the part played by submarines in actual combat with surface warships or fleets. It is an axiom of naval war that battleships should not be risked unless for a decisive object. Hence we find the British main fleet not roaming the sea as of

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old, but held back in a zone several hundred miles from the blockaded German coast, carefully guarded against submarine attack, but so situated as to be instantly available for action should the *decisive object*, the German high-sea fleet, leave its "hole." Meanwhile the blockade of the German coast was maintained by British submarines in the Heligoland Bight and in the Baltic, the former being supported by a secondary fleet formed into patrol flotillas of cruisers, gunboats, and destroyers.

If this is a mild example of their strategic influence we have a more striking illustration of their tactical value when acting in conjunction with surface fleets in the battle off Heligoland, when Sir David Beatty's victorious squadron was forced to break off the action and discontinue the chase of the defeated German cruisers, owing to the latter falling back to obtain the support of their submarines and mines at a rendezvous near Heligoland. Had the presence ahead of submarines and mines not menaced the British squadron, one large ship of which, the *Lion*, had been damaged, and was therefore very vulnerable to submarine attack, it is probable that several more German vessels would have been sunk. It appears that the German squadron was only saved from a decisive defeat by the menace of its submarines and mines. An action between a single battleship and a single submarine is seldom likely to occur, first, because it will become a rule of naval warfare that battleships should never be without a guard of destroyers, and, second, because the theory of submarine warfare points to the employment of more than one submarine in an engagement with a heavily armed surface ship, the under-water attack being

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delivered from two or more points simultaneously. The perfection of submarine wireless telegraphy and other known means of secret intercommunication between submerged warships will make co-operation possible.

The policy of attrition, or what may be termed the submarine phase in naval war, is merely the new application of the old strategic principle of the conversion of inferior into superior force. The efforts of the German naval staff to carry this principle into successful effect with the aid of submarines and mines, although foredoomed to failure owing to the utter inadequacy of the forces at their command compared with the strength of their enemies, affords a lesson in the new application of naval strategy which it would be extremely ill-advised to dismiss without consideration. Hitherto it has been the aim of naval strategists to cause a division of the enemy's main forces and then to occupy the *central position*, and to defeat each half of the enemy separately. An instance of this from recent warfare was the action of the Japanese in destroying the Russian Port Arthur fleet before the arrival of the Baltic fleet under Rozhestvensky, preventing in the meantime a junction between the Port Arthur and Vladivostok divisions by taking up a central position between the two. The German Navy, not being in a position to divide the concentrated British fleet, sought to reduce its strength by submarine and mine attack before any decisive engagements between the battle-fleets became necessary.

Every battle on land and sea teaches its lesson of concealment and sudden attack; and even as the huge siege guns and devastating artillery fire of land

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forces is causing the extension of the battle-front and the rapid burrowing under earth or entrenching of positions dearly won or with difficulty retained, so are the powerful 13·5 and 15 inch naval guns, combined with the rapidity and accuracy of the modern war-ship's secondary armament, necessitating the reduction in numbers of the big surface ships of the opposing fleets by frequent and daring submarine attacks prior to the decisive engagements between the battle-fleets. So far only the submarine side has been dealt with, but if a fair estimate is to be made this must be balanced by a survey of the modern methods of anti-submarine warfare, following the same principle of ignoring confusing details and dealing only with the broad issues.

Having now accomplished the object of this introductory chapter, and outlined very briefly the aim and scope of this work, which embodies the observations made during the fourteen years of rapid submarine construction, development, and warfare which have elapsed since my first articles and books on these subjects appeared in England and America, it is apropos, before plunging the reader into the details of strategy and tactics, supported by examples from modern warfare, to consider each advance made in the construction, perfection, and addition of submarine and anti-submarine fleets to the navies of the Great Powers.

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PART I

THE EVOLUTION OF THE SUBMARINE

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I

EARLY SUBMARINES

IN the year 1578 William Bourne designed a crude submarine vessel, which had a flexible inner hull, decreased or enlarged in size by a screw gearing for varying the displacement when sinking or rising. The joints in the flexible hull were made watertight by leather coverings, and there was a hollow mast for the admission of air. Bourne described in some detail the difficulties of submerged navigation in relation to the methods he suggested for overcoming them; but notwithstanding this, which lends colour to the belief that at least some practical experiments were carried out, there is an entire absence of any record of such a vessel having been built; and the general opinion is that both his design and ideas were purely theoretical.

The next historical mention of a submarine occurred in the year 1600, when a monk by the name of Mersenus wrote proposing a vessel of more elaborate design, which in the light of modern experience is a little difficult to understand. This submarine was to be constructed entirely of copper and to be "fish" shaped. She was to be fitted with guns having automatic plugs, ventilators for the supply of air, and phosphorescent bodies for the giving of light. Oars were the suggested means of propulsion, but

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wheels were to be provided for her to roll along the sea-bed, and she was intended "to destroy the keels of enemy's ships." It seems quite clear that no such vessel was ever constructed, as the monk lived for many years afterwards, but it is curious to note that this appears to be the first mention of wheels for submarines, an idea practically applied in quite modern times by Captain Simon Lake in his vessels *Argonaut I.* and *Argonaut II.*, built in the United States.

Five years later Magnus Pagelius wrote suggesting a means to enable vessels to navigate the underseas, but once again there is no record of the idea having reached the constructional stage. Van Drebbel, a Dutchman, is, however, generally credited with having constructed the first submarine boat, and used it on the river Thames in 1620. No drawings have been found, and even about this vessel there is a great deal of obscurity. Records state that passengers were carried safely from Westminster to Greenwich while submerged to a depth of from 12 to 15 feet, one passenger declaring that the light while under water was sufficient to read by! Van Drebbel claimed to renew the air supply by the "volatile liquor of the essence of air," but others assert that bellows were used to draw air down through a tube from the surface. The vessel was constructed of wood, and was propelled by twelve oarsmen. It has been stated that Van Drebbel's submarine was still on the Thames in the year 1645, when King James I. made a submerged voyage in her.

Father Fouriner published some general ideas on submarine navigation in the year 1640, but nothing practical came of them. In 1653, however, De Son

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constructed at Rotterdam a vessel intended to travel only in the awash condition. She is supposed to have been 72 feet in length, 8 feet in breadth, and 12 feet in depth, and to have been propelled by a paddle-wheel, or "rotary sucker," situated in the centre of the boat, the above-water parts of this vessel being plated with iron for protection in warfare. The clockwork engine, which was intended to run for eight hours, worked well on land, but when the vessel was launched it was discovered that the power was not sufficient to drive the wheel when in the water.

About thirty-six years later Denis Pepin constructed in France a small wooden vessel, 6 feet by 3 feet, which was propelled by oars and a plunger. Little is known of this boat, beyond the fact that it was built to the order of the Landgrave of Hesse-Cassel. In 1747 a vessel was built by Symons, which was the second submarine to be launched on the river Thames. It had a length of about 70 feet, and was propelled by oars worked through leather sockets. Sinking was accomplished by varying the displacement with the aid of leather bottles.

An Englishman, by the name of Day, in 1773 carried out experiments at Yarmouth in 30 feet of water with a small wooden boat. In the same year he went to Plymouth and converted an old 50-ton sloop into a kind of experimental submersible vessel, no mention being made of any means of propulsion. An airtight chamber was fitted in the centre of the vessel, which also had a detachable keel. Day made a successful shallow-water descent, and was induced to attempt a similar feat in 132 feet of water, where he was to have remained for twelve hours. The great pressure at this depth (58·7 lb. per square inch)

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was, however, more than the vessel and its airtight tank could stand, and the daring inventor lost his life. This is apparently the first mention of the use of detachable keels, which have since become quite a feature in several modern submarines.

We next come to the famous vessels built by Bushnell in America in the years 1774–76, and known as the "American Turtles." They were the first successful submarines, and all modern under-water craft have developed on more or less similar lines.

Bushnell's submarine was shaped like an egg, floating point downwards. In plan, however, the shape was elliptical. At the bottom end were ballast tanks into which water was admitted when it was desired to submerge. A vertical propeller, worked by hand, also assisted the diving and rising. At the top end was a raised conning-tower or hatchway. Inside the vessel there was only room for one man. There was also a hand-worked horizontal propeller for propulsion ahead or astern. It was the intention that these vessels should totally submerge and then slowly make their way towards hostile wooden ships, rise under them, and drive a screw into their bottoms, to which a magazine and clockwork fuse had been attached. A compass and pressure gauge, illuminated by phosphorus, were provided.

It was in one of these vessels that Sergeant Eyra Lee, in 1776, attempted to sink H.M.S. *Eagle*, and in the following year H.M.S. *Cerberus*. In both cases the magazine failed to explode beneath the vessel.

Robert Fulton constructed in France his famous submarine, the *Nautilus*, in the year 1801. She was built of copper plates on iron frames, and was 21½ feet

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in length by 7 feet in diameter. A vertical propeller, ballast tanks, and two hydroplanes were the means employed for diving and rising. She was driven by a hand-operated propeller which gave a speed of 2½ miles an hour, and carried a copper torpedo weighing 100 lb.

Fulton's submarine was demonstrated at Brest and Havre under the eyes of the great Corsican, who, however, placed greater confidence in soldiers than in ships. Pitt also, although convinced of the possibilities of the submarine and the torpedo, seeing in them a menace to British sea-power, successfully discouraged their use.

A vessel called the *Nautile*, built by Coessin Brothers, was launched in France in 1809, but proved quite unsuccessful; and in 1813 a small submarine, similar to that of Bushnell, was launched at New London. An attack was made in this vessel on H.M.S. *Ramilies*, which nearly proved successful. The attachment holding the magazine to the bottom of the *Ramilies* gave way just before the explosion, and although the warship was not sunk, several men were killed.

Robert Fulton, who had gone to America after his rebuff by England and France, was there building a new vessel, which he called the *Mute*. She was launched on the morning of the battle of Waterloo, and had the following dimensions: 80 ft. × 22 ft. × 14 ft. This submarine was, however, never completed owing to the death of the inventor.

The third submarine to be built on the Thames was launched in 1821. She was constructed from the designs of a Mr. Johnson, but proved unsuccessful; and in 1849 William Bauer launched at Kiel his

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well-known vessel, *Le Plongeur Marin*. This submarine had a surface displacement of 38½ tons, and was 26 feet long by 9 feet broad. She was driven by a hand-worked propeller, and diving and rising were accomplished by the admission of water into ballast tanks. Any deviation from the horizontal trim was corrected by sliding weights. It is generally believed that she was built of iron and had arm-pieces with indiarubber gloves for fixing mines, which were to have been fired by a voltaic battery. This is apparently the first historical mention of the use of an electric current from a submarine vessel. The crew of *Le Plongeur Marin* consisted of three persons, and several semi-successful trials were made, but in 1851 she sank, after the crew had escaped, and was not recovered for two years, and nothing further was heard of this vessel.

The fourteenth submarine to be actually launched was built on the shores of Lake Michigan in 1851 by a Mr. Phillips. She was practically cigar shaped, and was 40 feet in length by 4 feet in breadth and depth. Propulsion was effected by means of a hand-driven propeller. It is stated that the inventor, with his wife and children, spent twelve hours exploring the bottom of Lake Michigan in this vessel, and that he fired shots, up through the hulls of old vessels moored for that purpose on the surface, from a 6-pounder gun fitted in the roof of the submarine. This is the first mention of guns being mounted on submarines.

In the year 1854 a curious form of movable diving-bell was invented by Scott Russel. His idea was for men inside the bell to push it along as they walked on the floor of the sea. It seems scarcely

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necessary to state that this apparatus, which is supposed to have cost over £7000, was not a success.

The second submarine designed and built by William Bauer was launched at St. Petersburg in 1855. This time he named his vessel *Le Diable Marin*, and she was more or less successfully tried at Cronstadt. The dimensions were 52½ ft. × 12 ft. × 11 ft. She was propelled by hand, and had the sliding weight arrangements of his former vessel.

We now come to the famous French submarine *Le Plongeur*, designed and built by engineer Brun in 1858. She had a length of 149 feet, a breadth of 20 feet, and a depth of 10 feet. The surface displacement was approximately 420 tons. She was the first submarine to use an engine for propulsion, and was fitted with motors of 66 horse-power driven by compressed air at a pressure of 180 lb. per square inch. As will be judged from the horse-power of her engines in comparison with the displacement, the speed was very slow, amounting to barely 5 knots an hour; and the radius of action was very small owing to the small amount of compressed air which could be stored. Sinking and rising was accomplished by the admission of water ballast and also by plungers varying the displacement. Navigation was accomplished by two vertical rudders and one horizontal rudder. The armament consisted of a 10-foot spar-torpedo. A special feature was the carrying of a kind of lifeboat in the superstructure. The crew comprised twelve men.

As will have been seen from the description, this vessel was the first really practical submarine torpedo-boat to be evolved. Subsequently a vertical propeller was added to assist the diving and rising, but the

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trials proved only partially successful. As an experiment and a stimulus to submarine boat construction the effect of this vessel was as remarkable as it was world-wide.

During the American Civil War there were several small submarines known as "Davids" built at Charleston and placed on the Chesapeake River. One of these vessels was, however, intended only to travel awash; she was 50 feet in length and 9 feet in diameter, and had an open hatchway in the centre. A steam-engine and a single propeller drove her at 5 knots an hour. She carried a spar-torpedo and attacked the battleship *Ironsides*, which she damaged considerably, but swamped herself. Another of these wonderful little vessels attacked the battleship *Housatonic* with a spar-torpedo (134 lb. of gunpowder) and succeeded in sinking her, but again the submersible was destroyed, and, curiously, was found some years afterwards wedged in the hole her torpedo had made in the hull of the *Housatonic*. The third vessel of this type was called the *David of Hanley*, and was intended as a diving submarine, being completely enclosed and fitted with horizontal rudders. She was, however, propelled by hand, and could only do 4 knots an hour. This, however, did not prevent her from exploding a spar-torpedo against the *Minnesota*, which she damaged considerably, and succeeded in escaping to Richmond. The third was named the *Roanoka* and was propelled by steam. She succeeded in exploding a charge and damaging the propeller of the *Memphis*. The fourth and last of this type was stationed on the Chesapeake River, but does not appear to have accomplished anything worth noting.

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The "Davids" succeeded in sinking one and damaging three warships and compelling the Union Fleet blockading the coast to keep moving. This was the first time in history that submarine boats were actually used in naval warfare, if the unsuccessful attack on H.M.S. *Ramilies* in 1813 is excepted.

The *Stromboli* was launched at New York in 1864. She was designed by a Mr. Wood, and had the following dimensions: 75 ft. × 20 ft. × 7 ft. This vessel was driven by a steam-engine both on the surface and when submerged, but always had a ventilator above water. The surface speed was 10 knots. Submergence was accomplished by the admission of water ballast. Her armament consisted of a 30-foot spar-torpedo, with a charge of 200 lb. of gunpowder, electrically ignited.

In 1866 M. Jules Verne wrote his famous novel *Twenty Thousand Leagues under the Sea*, in which he gave such a remarkable description of a fictitious submarine called the *Nautilus*. In 1868 several vessels were built in Russia, one of which was propelled by compressed air. Very little is, however, known concerning these submarines, except that one, costing £60,000, was lost in the Transunds Roads. America's tenth submarine was built by Villeroi on Lake Michigan in 1869. She was 32 feet in length, and was equipped with a chemical respiratory apparatus which evidently proved very successful, as during one trial she was submerged for five hours with nine men aboard.

During the siege of Paris a small submarine was built by André Constantin. She had a geared propeller worked by two men, but was by no means successful.

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The *Intelligent Whale* was built by General Hoxsey at Newark, N.J., in 1872. She was 26 feet long and 9 feet broad. She was the first submarine to be fitted with a special air-lock, which enabled a diver to leave and re-enter the vessel when lying on the sea-bed. On one occasion, when the submarine was lying in 16 feet of water, General Sweeney, clad in a diving-dress, left the vessel through the air-lock, placed a mine under a hulk moored on the surface, and, after returning to the vessel, exploded the mine by means of an ordinary lanyard and friction primer. The *Intelligent Whale* was purchased by the American Government, and after several trials was laid up, eventually being preserved at Brooklyn.

Two submarines were launched during 1876; one was the invention of an Englishman by the name of Garrett, and was built at Birkenhead. She was 14 feet in length and 5 feet in diameter, and was cigar shaped. Submergence was accomplished by the inlet of water ballast and by varying the displacement with the aid of plungers. Propulsion was by hand-worked propellers; and leather gloves were fitted for attaching small mines to the bottoms of hostile war-ships. The other vessel launched in this year was also quite a small experimental submarine designed by M. Drzewiecki and built at Odessa in Russia. The length was 14 feet, the beam 5 feet, and the depth 4 feet. She had a foot-driven propeller, and was submerged by the inlet of water and by plungers. Neither of these vessels were really successful, but both inventors produced larger vessels during 1879.

Garrett's new submarine was named the *Resurgam*, and was built at Birkenhead by the constructors of his first boat. She was 45 feet long and 5 feet in

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diameter. Diving and rising were accomplished by the admission of water into specially constructed ballast tanks, the use of plungers, and by central horizontal rudders for navigation when submerged. The reserve buoyancy was 100 lb. She was driven by a steam-engine operating a single propeller. When submerged, the necessary heat was stored in hot-water tanks on Lamm's principle. Her speed below the surface was from 2 to 3 knots an hour. Several successful trials were made by this vessel on the river Mersey, but she was eventually lost on the Welsh coast. The inventor then joined hands with Nordenfelt, and they built their first vessel at Stockholm in 1885.

Drzewiecki's second submarine was 20 feet in length by 8 feet in diameter. She was propelled at a speed of 4 knots by hand-power. Submergence was accomplished by horizontal planes and sliding weights. Fifty of these small submarines were built for the Russian Government, the intention being to carry them aboard surface warships, but eventually they were converted into pontoons. M. Drzewiecki next turned his attention to designing the special automatic holder for torpedoes which bears his name and is used on many modern French submarines.

The next five experimental boats were from the designs of Mr. J. P. Holland of Patterson, New Jersey, and were the forerunners of the type since adopted by the British, American, Japanese, and other navies. It was in 1877 that Holland launched his first vessel, which was 16 feet long and 2 feet deep. It was more an under-water canoe than a submarine boat, for the head and shoulders of the operator projected above the decking, and were encased in a diver's helmet, while he worked with his

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feet the propeller through suitable gearing. The two conical ends were occupied by water ballast and compressed air. The experiments carried out with this little vessel led to the construction of the Holland No. 2 in the same year. She was built at New York, and was 10 feet long and 3 feet 6 inches in diameter. This vessel had a double skin with water ballast between, and was fitted with a 4-h.p. petroleum motor and a horizontal diving rudder in the stern. After a few trials this vessel was abandoned, and the Holland No. 3 was launched in 1881 at New York. Again the size was increased, for this submarine had a displacement of 19 tons and was 31½ feet in length by 6 feet in diameter. A 15-h.p. Brayton petroleum motor was used for propulsion, and submergence was accomplished by the admission of water into the ballast tanks, but she dived with a reserve buoyancy, using her horizontal rudders but no vertical propeller. A submarine gun, fired by compressed air, was her only arm. This vessel was also abandoned; and the Holland No. 4 was built at Jersey City. This boat was intended as a model, and had a displacement of only 8 tons, being 16½ feet in length and 2 feet 4 inches in diameter. She sank with the conning-tower hatch open, and was lost. The Holland No. 5, known as the Zalinsky boat, was constructed at Fort Lafayette, and had a length of 30 feet with a diameter of 7 feet. She was armed with two Zalinsky pneumatic dynamite guns. She ran on some rocks, but was successfully refloated. The Holland No. 6 was never actually built, being simply a design for a vessel with a low freeboard. The Holland No. 7 (and subsequent vessels of this type) was not launched until 1896.

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In 1881 the *Fenian Ram* was built and launched on the Hudson River. She was a small cigar-shaped vessel, driven by a compressed air-engine and armed with a pneumatic gun.

In the same year M. Goubet built his first submarine in France. She was 16 feet 6 inches long by 5 feet 9 inches broad, and weighed 11 tons. She was the first submarine to use electric accumulators and an electric engine for surface and submerged propulsion. Her speed was 4–5 knots on the surface and 2–3 knots when submerged. Her armament consisted of two loco torpedoes carried in holders on the outside of the vessel. It was the intention that she should be carried on board a big surface warship and launched in an action at the critical moment. The *Goubet I.* had a combined rudder and propeller, and scissors for cutting torpedo-nets. She was sold to the Government of Brazil for £10,000. In the same year the *Goubet II.* was built at Cherbourg. She had a length and breadth of 26 feet and 6 feet respectively. She was propelled by electricity, and sufficient air for a nine hours' submergence was carried. This vessel was sold for pleasure trips on Lake Geneva. The third Goubet boat was built in Russia in 1882, and had a surface displacement of 2½ tons. She was driven by foot-power (four men) at a speed of about 3 knots an hour, and was tilted for diving by sliding weights. Her chief feature was the supply of chemical and compressed air sufficient for twenty-four hours' submergence.

The *Nautilus*, which was designed by Messrs. Ash and Campbell, was launched at Tilbury in 1885. She was 60 feet long, 8 feet in diameter, and had a

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displacement of from 50 to 60 tons. This was the first vessel to be fitted with twin screws, and to have a long superstructure (20 ft. × 2 ft.). She was driven by electric engines rotating the propellers at 750 revolutions per minute. Her speed was 10 knots on the surface and 6 knots when submerged; and she carried sufficient stored electricity for a ten hours' cruise at full speed. Submergence was accomplished by the admission of water into the ballast tanks, and four plungers on each side. She had horizontal and vertical propellers, and a reserve buoyancy of about 150 lb. A watertight compartment enabled a diver to leave and re-enter the submarine when on the sea-bed. The crew consisted of six men. When undergoing a trial on the Thames she dived into the mud of the river-bed, and was only extricated by the strenuous efforts of the crew, who moved quickly from one end of the vessel to the other, causing her to plunge and to shake herself free of the clinging slime.

The first of the Nordenfelt boats, the *Nordenfelt I.*, was launched at Stockholm, Sweden, in 1885. She was built from the designs of Nordenfelt and Garrett, and was 64 feet in length and 9 feet in diameter, with a surface displacement of just over 60 tons. The driving power was obtained from a steam-engine of 100 h.p., and heat was stored on Lamm's system for use when submerged. The surface speed and radius was 7 knots for 150 knots, and when submerged 4 knots for 16 knots. This vessel had a reserve buoyancy when travelling under water of about 650 lb. Submergence was accomplished by the admission of water ballast and with the aid of a vertical propeller placed on each side of the vessel

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amidships. A 6-h.p. engine operated these two vertical propellers, which exerted a downward or upward thrust, and there was a system of automatic control for diving and maintaining any given depth. The armament of the *Nordenfelt I.* consisted of an external bow torpedo-tube and a Nordenfelt gun. Sufficient compressed air was carried for a six hours' cruise.

This vessel proved remarkably successful when running on the surface and awash, but acted erratically when submerged, making long up-and-down glides. She was, however, sold to the Greek Navy in 1886 for the sum of £9000, after a very successful trial in the Bay of Salamis.

Waddington's submarine *Porpoise*, which was built at Seacombe in 1886, was 37½ feet in length by 6 feet in diameter, and was propelled by electric accumulators and an 8-h.p. motor. Two vertical propellers working in tubes passing completely through the hull assisted the diving and rising, but water ballast and horizontal rudders were also used. The complement was two men, and sufficient compressed air was carried for six hours. The speed of this vessel, both on the surface and when submerged, was very slow; and the trials were by no means satisfactory.

The second and third Nordenfelt boats were constructed at Chertsey in 1887. These had a length of 100 feet and a diameter of 12 feet, and were of 160 tons surface displacement. They were propelled by steam-engines of 250 h.p.—using the Lamm system of heat storage when running submerged. Their speed on the surface was 9 knots, and when submerged 5 knots. The surface radius

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was 250 knots, but the submerged radius scarcely amounted to 20 knots. The vertical diving propellers were placed at each extremity for diving and rising; and the armament consisted of two external bow torpedo-tubes fitted with 14-foot torpedoes, which could be discharged while the vessel was travelling submerged, but fresh torpedoes could, of course, not be placed in the tubes. They also carried two 1-inch Nordenfelt quick-firing guns. These two Nordenfelts, although erratic when diving or running submerged, were purchased by the Turkish Government. The fourth Nordenfelt submarine was constructed at Barrow in 1887. She was 125 feet long and 12 feet in diameter, the surface displacement being 160 tons. This vessel was given more powerful engines than had ever before been tried in a submarine, and were of 1000 h.p. steam driven. The surface speed and radius was 14 knots for 1000 knots, and submerged 5 knots for 20 knots. Fore and aft vertical propellers assisted the diving and rising; and the reserve buoyancy amounted to about 500 lb. The armament consisted of two torpedo-tubes. The *Nordenfelt IV.* was tried very successfully in Stokes Bay, and was the object of much interest in the Naval Review of 1887. The principal fault of this vessel was erratic behaviour when submerged, which made submerged travelling in shallow water somewhat risky. She was sold to the Russian Government, but unfortunately ran ashore on the voyage out, and was sold to meet the salvage charges.

The first Spanish submarine was a boat called the *Peral*, designed by Isaac Peral and launched in 1887. She was 70 feet in length by 8½ feet in diameter, and

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had a surface displacement of 87 tons. She had twin screws driven by electric motors of 30 h.p. (combined). The current was obtained from 420 accumulators. Two vertical propellers, driven by 5-h.p. engines, were used to assist the diving and rising. The armament consisted of one bow Schwartzkopf torpedo-tube, and she was built for use as a ram. The principal trial of this vessel took place during the summer of 1890 in Carraça Bay, when the submarine succeeded in torpedoing the armoured cruiser *Christobal Colon*, but this, even in those days, proved little, for the attack took place at night, and the *Peral* was allowed to submerge before the cruiser was permitted to use her searchlights. The *Peral* had a searchlight for surface use. This vessel, like those designed by Nordenfelt, was very erratic when running submerged.

The first French naval submarine was launched in 1888. This vessel was named the *Gymnôte*, and was designed by M. Dupuy de Lôme, who unfortunately died before his plans were quite completed, but his more than half-finished designs were taken in hand by his friend, M. Gustave Zédé, a retired naval engineer. This clever designer added many improvements to the original design, and some time later offered the completed plans to the Minister of Marine, Admiral Aube—the father of French submarines. M. Zédé's plans were accepted; and France, by this move, opened a new era in naval construction.

The *Gymnôte* had a surface displacement of about 30 tons, and was 60 feet in length by 6 feet in diameter. She was propelled by an electric motor at 7 knots an hour on the surface and about 4½–5 knots an hour when submerged. Diving and rising were

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effected by two vertical propellers and two hydroplanes. The armament consisted of two outside torpedo-tubes. This vessel was put through a long series of very exhaustive trials off Toulon, lasting several years, and proved generally satisfactory. She was still in commission in 1907, when she struck a rock, but rose to the surface on releasing the safety weights with which she was provided.

The next vessel to be acquired by the French Government was the famous *Gustave Zédé*, which was launched at Toulon in 1893. This vessel, which was built from the designs of M. Romazotti and M. Gustave Zédé, was 148 feet in length and 10 feet in diameter, her submerged displacement being 266 tons. She was propelled by electric engines of 360 h.p., and was armed with one *internal* bow torpedo-tube, with three small torpedoes. Her speed was 9 knots on the surface and 5 knots when submerged. At first this vessel proved very unsatisfactory, and met with many mishaps; but some years later, owing to certain drastic changes, she turned out a brilliant success and did much to encourage the construction of a submarine torpedo-boat flotilla for the French Navy.

In 1896 the Holland submarine No. 7 was launched in the United States. She was 55 feet in length, 10 feet in diameter, and had a surface displacement of 74 tons. A 150-h.p. petroleum motor coupled to a single propeller drove her at 8 knots an hour on the surface. Her armament consisted of one internal bow torpedo-tube; and she carried a crew of five men. This vessel was acquired by the United States Navy. In the following year the Holland experimental boat, *Plunger*, was launched at Baltimore.

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She was 85 feet in length by 11½ feet in diameter, and had a surface displacement of 155 tons. Unlike all the other vessels of this type, she was fitted with quadruple expansion steam-engines and an oil-burning water-tube boiler, for surface propulsion, with electric motors of 70 h.p. for submerged use. The surface speed and radius was 10 knots for 240 knots, and submerged, 7 knots for 48 knots. Her armament consisted of two internal torpedo-tubes, with five short Whitehead torpedoes.

The third submarine launched for the French Navy was a vessel named the *Morse*, which was built at Cherbourg from the designs of M. Romazotti in 1899. This vessel was similar in construction to the *Gustave Zédé*, but was of smaller size, being 118 feet long by 8½ feet in diameter, with a surface displacement of 136 tons. She had electric engines for both surface and submerged propulsion of 360 e.h.p., which gave her a speed of 9 knots on the surface and 7 knots when submerged. Her radius of action was 100 knots. The armament consisted of one bow torpedo-tube with three short Whitehead torpedoes. The cost of this vessel was about £26,000.

The fourth submarine vessel to be launched for the French Navy was of an entirely different type, and was known as the first *submersible torpedo-boat*. She was named the *Narval*, and was launched at Cherbourg during the latter part of 1899. This vessel, which was designed by M. Laubeuf, was the direct outcome of a competition instituted by M. Lockroy, Minister of Marine, in 1896. It was hoped by means of this competition, open to the genius of France, to obtain the designs for a

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perfect submersible vessel. A comprehensive programme *d'experience* was drawn up, which all designs would be expected to fulfil when put into practice. It was to act also as a guide to competing inventors.

The designs sent in were very numerous, and many small prizes were awarded. Although the result of this competition did not produce the "ideal submersible," it brought out many valuable suggestions, and created a new and very efficient type, the *Laubeuf Submersible*—vessels of which design have since been constructed for the French and British Navies.

The *Narval*, the first of this type, could navigate on the surface like an ordinary torpedo-boat, semi-submerged, with nothing but the conning-tower and funnel above the water; and also totally submerged like a submarine. She was built with a double hull, the outer casing being shaped like an ordinary surface torpedo-boat, and the inner shell cylindro-conical. Water ballast was carried between these two skins as a protection against shock from exterior explosions. When totally submerged the water circulated freely between the two hulls.

The *Narval* had a surface displacement of 106 tons and a submerged displacement of 169 tons. She was 116½ feet in length and 12½ feet in breadth. Her draught in the light or surface cruising condition was 5 feet 3 inches. She was propelled on the surface by a 250-h.p. steam-engine with an oil-burning flash boiler, and, when submerged, by an electric engine deriving its current from Fulmen accumulators, which, when the vessel was travelling on the surface, could be recharged from a dynamo, driven by the

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surface engine. She attained a maximum trial speed of 12 knots on the surface and 8 knots when submerged. Her radius of action was (surface) 250 knots at 12 knots, or 500 knots at 7½ knots; (submerged) 25 knots at 8 knots, or 72 knots at 5 knots. Four hydroplanes, two aft and two forward, assisted the diving and rising. The armament consisted of four Drzewiecki launching tubes, fitted on the arched back of the vessel. These held 45 cm. (long) Whitehead torpedoes, and could be fired at various angles.

The *Narval* had two great faults. One was the length of time taken to totally submerge, a minimum of twenty minutes being required for this manœuvre. The other was that the steam-engine, used when on the surface, retained the heat to such an extent that it was often impossible for the vessel to submerge until the engine had cooled. These drawbacks have all been overcome in the later vessels of this type, and even the *Narval* was considered by the French naval authorities to be the most successful submarine afloat at that time.

In 1900–1 the British Admiralty commenced the formation of a submarine flotilla with five vessels of the Holland type. In the same year two submarines were launched for the Russian Navy. France, Italy, and the United States had already adopted this type of torpedo-boat, and during the first five years of the twentieth century every important navy commenced the construction of powerful submarine fleets. The advent of the submarine as a vessel of war opened a new era in naval history and revolutionised the older theories of sea-power.

In the following section the development of the

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submarine from the weak experimental vessel, looking apparently in vain for official approval, to the powerful submarine cruisers of to-day will be continued. From this date (1900–1) they gradually passed out of the experimental into the practical stage, and became part of the fleets in being.

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PART II

DEVELOPMENT OF THE SUBMARINE FLEETS OF THE GREAT NAVAL POWERS

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I

SUBMARINES AS PART OF THE "FLEETS IN BEING"

IT may appear at first sight that this and the preceding section are historical digressions. From a purely practical point of view this may be correct, but even as the introduction of steam as a motive power for ships in the nineteenth century gradually revolutionised the theory of naval war, so has the evolution of the submarine. Steam is not without its limitations, for—"while it has given increased certainty and quickness of movement to fleets, [it] has also imposed upon them such fetters, by the need of renewing their fuel, that naval enterprises can no longer have the daring, far-reaching sweep that they once had, but must submit to rules and conditions that armies have long borne. . . . Very long and distant operations would be undertaken by the derided sailing ship, because sure that there was no article of absolute necessity which it could not find wherever it went. The occasional embarrassment of food and water were met by the accommodating human body submitting to half-rations. With coal, communications have come; and communications mean that link by link, even if the links be long, the expeditionary force must be bound to the home country as a base."[1]

[1] Admiral Mahan in *Naval Strategy*.

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To what extent is this the case with the submarine? Questions like this can only be answered and understood when the scope and limitations of the weapons themselves, in this case the submarine, have been studied in relation to the actual conduct of naval war. Again we have the principle expounded by Mahan that every increase in the size of warships effects the application of naval strategy.

Having reviewed the various stages in the evolution of the submarine from an experimental theory to a practical fact, there remains to examine its rise from the weak, handicapped torpedo-boat to the well-armed cruiser with good speed and wide range of action. This can best be accomplished by division under the headings of the various naval powers engaged in the rivalry for sea dominion, as each has followed its own line of progress, dictated by the general trend of scientific discovery, which is an immutable law in the evolution of all weapons of warfare.

Great Britain

For several years previous to the launch of the first British naval submarine from the yard of Messrs. Vickers Limited at Barrow-in-Furness, in 1901, officers specially detailed by the Admiralty had been watching closely the development of the various types of submarine vessels in all countries. Although a large number of designs, some practicable and many technically impossible, had been, from time to time, placed before the authorities, there were really only three modern types which had been tried successfully in practice. These were the *Holland* (American), the *Lake* (American), and the *Laubeuf* (French).

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All these differed from each other in essential features. The *Holland* submarines were of the purely *diving type*, *i.e.* dived under the surface at a forward angle by the action of the passing water on horizontal rudders, after the buoyancy had been reduced to a minimum by the inlet of water ballast. The *Lake* submarines were of the *even-keel submergence* type, anchor-weights being lowered on to the sea-bed, the margin of buoyancy reduced to a minimum, and the vessel hauled down by power-reels winding in wire hawsers attached to the anchor-weights. The *Laubeuf* submarines, or submersibles as they were called, which had double hulls and steam-engines for surface propulsion, required the inlet of a large quantity of water ballast (owing to great surface buoyancy) before they settled down into diving trim, when they were driven under by the action of the water on four hydroplanes, two each side of the vessel, fore and aft; but they slid under the surface *on an even keel.*

As this work is devoted to naval and not engineering problems, it is sufficient to say here that the Admiralty decided in favour of the first of these three types; and arrangements were made with the Holland Company in America for the construction of vessels of this type by Messrs. Vickers Limited for the British Navy. Practically the first official notification that England was to possess a submarine torpedo-boat flotilla appeared in the Naval Estimates for 1901–2: "Five submarine vessels of the type invented by Mr. Holland have been ordered, the first of which should be delivered next autumn."

These were the vessels designated Nos. 1–5. They had a submerged displacement of 120 tons, a

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speed of 8½ knots above and 7 knots below the surface. Their armament consisted of one bow torpedo-tube with three Whitehead torpedoes. A series of exhaustive trials with these five vessels, launched during 1901–2, proved conclusively the fighting value of this type of craft, and a further order was given by the Admiralty for four new vessels embodying the improvements suggested by the trials of the first five. These were the first of the "A" class, and were designated the A's 1, 2, 3, and 4. They were launched during 1903, and had a submerged displacement of 180 tons, a speed of 11 knots on the surface and 7 knots when submerged. Their surface range of action was 400 knots. The armament was increased (A2 onwards) to two bow torpedo-tubes with four Whitehead torpedoes. All these vessels became obsolete and were removed from the active flotillas by the year 1914.

The next submarines to be completed for the British Navy were the vessels A5 to A13, launched in 1904. They had a submerged displacement of just over 200 tons, and an above and below water speed of 11 and 7 knots respectively. Their armament remained the same as in the earlier vessels of this class.

The period of experiment and trial having now been successfully passed, the additions to the submarine flotillas of the British Navy became rapid and ever increasing in the size, speed, and offensive power of units. At least 200 vessels were launched between 1904 and 1918, which varied in size from 200 to 1500 tons. The object of this work being to show the changes effected in naval war by the advent of the submarine, and not to usurp the place

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of the *Naval Annual* and that excellent work of reference Jane's *Fighting Ships*, it is patent that no detailed description of individual vessels is here possible; but, without a knowledge of the progress made in the construction and perfecting of underwater craft, much that will hereafter be said concerning their powers of offensive would be incomprehensible. To avoid this without entering into a technical description of the details of modern submarines is a difficulty which it has been sought to overcome by reviewing at the end of this chapter the improvements made in the fighting qualities of the submarines of all nations.

France

To France belongs the honour of being the first naval power to adopt the submarine as a unit of the fighting fleet; although the "Davids," famous in the American Civil War, the purchase by the United States Government of the *Intelligent Whale*, and certain small vessels built for, but never actually employed by, the Russian Navy, may claim priority. It has already been described how France commenced the formation of her now powerful submarine flotilla of over 180 vessels by the launch of the *Gymnôte* in 1888, followed by the *Gustave Zédé* in 1893, the *Morse* in 1899, and the *Narval* in 1899.

The first tentative steps were followed by ten years of experiment and trial, and it was only in the years 1897–8–9, which included the now forgotten Fashoda incident, that France, having "obtained the certainty of effective submarines, launched out resolutely by laying down six more."

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These were the vessels *Farfadet* (renamed *Follet*), *Lutin*, *Korrigan*, and *Gnôme* of one type, and the vessels *Française* and *Algérien* of another type. All these vessels were built at Rochefort, and were completed during 1901–2.

The flotillas of the French Navy are composed of two different types of vessels, *Submarines Defensive* and *Submersibles*. The former are intended, as their name implies, solely for coast and harbour defence; their range of action is very small, and they cannot operate far from a naval base. The Submersibles are large sea-going submarines, similar to those of Great Britain, and have a wide radius of action, high speed, and a powerful armament. The reason of this division is given in a report of M. Charles Bros, the referee of the French Naval Budget in 1905. "Military politics must needs accommodate themselves to general politics, following the same evolution and taking identically the same view," and it was at this date generally considered to be politic for the French Navy to concentrate on national defence, whilst able to act on the offensive if necessary. This theory is similar, if not identical, with the old Russian naval policy of a defensive or fortress fleet, as opposed to a high-sea fleet, and is the policy so forcibly condemned in Admiral Mahan's great work on naval strategy.

Up to quite recent times France has continued to alternate between submarines of large size with ocean-going qualities and small vessels for coast and harbour defence. The great advantage, however, that France gained by being early in the field with submarine construction has enabled her to keep pace with England, and about 180 vessels have been

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launched since 1901, varying in displacement from 50 to 1400 tons.

In comparing the progress made in submarine construction in France since the adoption of this type of craft as an integral portion of the fleet in the period 1888–93, with that made in England since 1901, with Germany since 1905, Italy since 1894, Russia since 1902, or with the United States since 1897, it will be found that, notwithstanding the secrecy with which the designing and construction of these vessels are surrounded, the necessary reliance upon the scientific brains and discoveries of the world for every important improvement of mechanism or equipment, causes all navies to take a parallel method of development and to produce almost simultaneously, although working secretly and semi-independently. A temporary increase of a few hundred tons displacement, a gain of a few knots speed, the addition of a new or more powerful weapon in the latest submarine of one naval power, is more often than not made possible by some discovery in the everyday scientific world which is known to all naval constructors of ability; but a method of converting that discovery for the improvement of submarines may be at first "spotted" by only one designer, with the result that the nation whom he serves gains a temporary lead in this detail. This, however, is sufficient to give the required stimulus to other naval powers, whose admiralties turn to their constructors with the peremptory order, "Go thou and do likewise." The constructors—when the intelligence departments fail—knowing the general principles underlying submarine construction, cast round for the new application, and if one con-

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structor fails, another succeeds, and so the game goes on. Only by a *coup de main*, such as that effected by England with the launch of the first Dreadnought, by Germany with the sudden production of the 17-inch siege gun, and by the British Tanks, can material progress now be made by one nation over another in the fighting power of submarines.

For the possibilities of one nation gaining an advantage over another in this important respect attention must be paid to (*a*) an adequate number of well-informed designers, and (*b*) to the speed of submarine construction. With the former France has always been well supplied, but in the latter essential she fell lamentably behind for many years, and it is only during recent times that this deficiency has been partially made good. Glancing at an Official French Naval Report issued in 1905, we find that it took thirty months to build a submersible and eighteen months to complete a submarine in France at this period; and an authoritative article in *Le Temps* of similar date shows clearly that several of the French vessels have taken from two to four years to construct.

In England during the same period the largest submarines were completed in eighteen months, and in the United States in fourteen months.

The reason for this, from the French point of view, can only be attributed to a series of factors, important among which was the method of construction. (1) State engineers were entrusted exclusively with the arrangements for the construction of these vessels after the designs had been approved. (2) All the interior mechanism and equipment was supplied exclusively by private firms. (3) State

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dockyards constructed the hull and fitted all the parts together; and (4) much of the experimental work with each completed vessel was carried out by the naval crews, who should have been training to fight the submarines and not to improve them, other than by suggestion as to requirements.' An extract from *Le Temps* on this point is interesting:

"Thus in France there exists a triple collaboration between the engineer of the rue Royale, who conceives the project of the boat, the arsenal, which builds the hull and does the mounting, and, finally, the private industry (generally in Paris), which furnishes the whole interior fittings.

"Can we then wonder that delays occur, if we think of the many alterations in ideas necessitated in the construction of a submarine in three establishments, frequently hundreds of kilometres from each other?

"Into this primary fault the English Navy has not fallen, for the Barrow yards have executed in full the 28 Holland submarine boats, forming the British flotilla, commencing with the design, following this up with the execution of the material throughout, and ending with the reception trials.

"It must be acknowledged that this centralisation has the advantage of speedy construction. But there is another advantage, more precious still: It allows the designer, who has made the plan, the establishment where the engines are built, the yard where the hull is being mounted, to find out immediately at the definite trials at the one place, whether the idea in the conception of the boat was a good one, to see what alterations are necessary and what means must be taken to avoid in future a recurrence of the same mistakes."

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For many years France oscillated between vessels of large and small tonnage, whereas in England and later in Germany the displacement steadily increased; and discussion in the former country raged as to the value of submarines against submersibles, whereas the two types were gradually approaching the unification which has since been effected.

The result of all this has been that France, unfortunately, lost much of the thirteen years' start she at first gained in submarine construction, and her fleet of under-water fighting ships at the opening of the Great War was perhaps equal to, but certainly not superior to, that of Great Britain.

Russia

Although in 1879 the Russian Government purchased fifty small submarines of the Drzewiecki type, these vessels were never placed in commission, being converted into pontoons and buoys. The first submarine torpedo-boat launched for the Russian Navy was a small vessel named the *Petr Kochka*, designed by Lieutenant Holbasiev and M. Kutenikov (naval engineer), and completed at Kronstadt in 1902. This vessel had a surface displacement of only 60 tons, and was built in nine sections to facilitate transport over the Siberian railway to Vladivostok. This little vessel, which proved very successful on most of her trials, was withdrawn from the active flotillas many years before the European War.

The next submarine to be launched for the Imperial Russian Navy was the *Delfin* (1902), that unlucky vessel which caused the death of so many Russian sailors at Kronstadt. The accident was,

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however, not due to faulty design, but to the incompetence of her crew.

The four vessels which followed were named *Graf Cheremitieve*, *Kasatka*, *Nalim*, and *Skat*, and were launched in 1904–5. They had a submerged displacement of 200 tons. Russian naval authorities awoke to the value of submarines in 1902–4, since which date about 70 vessels, varying from 200 to 1000 tons, have been completed, and a large submersible cruiser of over 4000 tons was ordered during 1917.

Although early in the field with the small submarines of the Drzewiecki type (1879) no serious efforts to form a submarine flotilla for the Russian Navy were made until after the launch and trials of the *Petr Kochka* and the *Delfin* in 1901–2–3. The successful trials of these vessels, which included some remarkable surface cruises from Kronstadt to Björkoe by the *Delfin*, combined with the submarine activity in other countries, apparently stimulated official action, with the result that no less than four vessels were laid down in 1903.

Russia, owing to climatic conditions, can employ submarines with greater advantage than countries with more temperate climates. For several months in the year her northern harbours and coasts are naturally defended by ice, and during these months the submarines can be docked and thoroughly overhauled—a more or less frequent operation which is very essential to the efficient working of these complicated craft. For another four months out of the twelve, the almost perpetual daylight would render the chances of a successful attack by surface torpedo-boats or destroyers very remote. At the same time, the peculiar light, combined with the brackish state

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of the water of the Baltic, would render the submarine even more invisible—if possible—than in southern seas.

United States

Although the "American Turtles," built by Bushnell in 1776, and in later years the "Davids," which were used in the Civil War, were really the first submarines to participate in naval warfare, they cannot be considered as the forerunners of the modern United States submarine flotillas. Historically, the first vessel of this kind purchased by the Government was the *Intelligent Whale*, which was built by General Hoxsey at Newark in 1872. This crude submarine was, however, never actually employed as a unit of the fleet; and it was not until after the long series of experiments carried out with several vessels of the Holland type that the United States Government finally purchased the *Holland VII.*, which was built at Elizabethport, New Jersey, in 1897. The vessel, although principally experimental, actually took her place in the active list, and became the first United States naval submarine. She was the forerunner of a large number of vessels of the same type, built not only for the navies of America and England, but also for those of other powers. More exhaustive tests were carried out with the *Holland* than with any other submarine afloat; and, in most cases, she acquitted herself remarkably well. Among the many expert naval officers who, from the first, strongly advocated the formation of a submarine flotilla for the United States Navy were Admiral Dewey and Rear-Admiral Philip Hichborn. The former made the following observations regard-

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ing the trials of the *Holland* before the House Committee on Naval Affairs in April 1900: "The boat did everything that the owners proposed to do. And I said then, and I have said it since, that if they had had two of those things in Manilla I never could have held it with the squadron I had."

It was the successful trials of the *Holland*, which was by far the most efficient submarine built at that date, that caused Great Britain to commence the acquisition of a submarine flotilla; and an order for six more submarines of the same (but improved) type appeared in the American Naval Estimates for the following year. These vessels were launched during the years 1900-1-2, and had a submerged displacement of 122 tons. With the start thus given the United States submarine flotilla progressed rapidly, and in seventeen years about 100 vessels were constructed with displacements varying from 122 to 800 and 1500 tons.

Many millions of dollars have been spent in perfecting this type of warship in the United States; and not America only has benefited by the wonderful progress made, but also the navies of many powers. It was the success of the Holland type which induced Great Britain, Japan, Holland, and other countries to commence the formation of a submarine flotilla. The Lake type attracted the attention of Russia, Germany, Austria, and other Powers; while the early experiments of the American pioneers were closely and profitably followed by the naval authorities of all nations. To France, who was first in the field, and to the United States, as an ingenious and practical second, must therefore be accorded the honours of being the pioneers in submarine construction and navigation.

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Comparing the increase in the submarine fleet of the United States with that of several other naval powers, we find that in the twenty years previous to the war, she added 51 submarines to the Navy with a total (submerged) displacement of 18,420 tons, compared with England's 94 vessels of 52,992 tons, France's 104 vessels of 48,216 tons, Germany's 100 vessels of 51,600 tons, and Russia's 48 vessels of 19,905 tons.[1] It should, however, be remembered that America, England, France, Germany, and Italy are the builders of submarines for many of the smaller powers. Their individual output is therefore much larger than appears by the addition in numbers and tonnage to their own naval flotillas.

Public, political, and expert opinion in the United States has long been in favour of the formation of a powerful submarine flotilla. First came the open advice of Admirals Dewey and Hichborn in 1900, which gave the lead to many advocates from all the platforms of publicity. In 1907 President Roosevelt said: "I thoroughly believe in developing and building an adequate number of submarines"; and in quite recent times (1915) the Naval Secretary, in his address to Congress, said: "In view of the demonstrated power of the submarine, I would impress upon Congress the importance of making a larger increase in the submarine craft, appropriating generously, therefore, without reducing the appropriations for other craft."

GERMANY

Although the first submarine boats built for the German Navy were two vessels of the Nordenfeldt

[1] Up to 1915.

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type, launched at Kiel and Dantzig in 1890, which were purely experimental, and have long been out of commission, it was not until the launch of a vessel designated the "U1"—the first of the Krupp type—from the Germania Shipyard, Kiel, on 30th August 1905, that Germany commenced the construction of a submarine fleet. Much uncertainty was at first displayed by the Ministry of Marine regarding the value of submarines in naval war, but the trials of this vessel, which extended over a year and a half, all proved remarkably satisfactory. It was at a secret trial in Eckernforder Bay that the German Emperor saw the U1, travelling at full speed, torpedo a moving target. The Krupp submarines are of *the even-keel submergence* type.

In 1907 the German naval authorities began to realise more fully the important part that submarines would play in future naval warfare, and commenced in earnest the construction of a powerful under-water flotilla. In 1908 a prominent Admiral advocated the immediate construction of sixty vessels, and in the same year over £300,000 was provided in the Naval Estimates for submarine construction.

The evolution of the German submarine from a comparatively small and slow under-water torpedo-boat into a large and fast sub-surface cruiser, capable of undertaking independent action in the Atlantic and returning to its base, has been wonderfully rapid. In little over ten years Germany constructed a flotilla of 150 vessels of her own Krupp type, which steadily rose in submerged displacement from 236 tons to approximately 1500 tons. Germany was the first to install 5-inch guns on her naval submarines, and her flotilla had been singularly devoid of serious disasters

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during peace manœuvres. During the years immediately preceding the European War, many of the various parts had been standardised for a series of six vessels allowing for spare parts and complete overhauling. It was by this system, adopted so successfully for the Taube aeroplane, that Germany was able to build submarines so rapidly when compared with her comparatively limited sources of output. It must be remembered that although the U1 was launched in 1905 it was not until after the launch of the U2 in 1907–8 that Germany commenced in earnest to construct a powerful submarine flotilla. In addition to her own naval submarines, she also supplied vessels to Russia and Austria, and many of her slips were during the same period occupied by surface warships under the accelerated programme. Notwithstanding all these factors, Germany produced about fifteen or sixteen large submarines a year since 1908, the average time occupied in the construction of each vessel being from nine to twelve months. During the years 1913 and 1914 the personnel of the German submarine service was largely increased, and the command of the flotillas was separated from that of the other torpedo-boats, a flag-officer being appointed as head of this branch of the Navy, with headquarters at Kiel.

AUSTRIA

Austria commenced the formation of a submarine flotilla by the acquisition of two vessels of the Improved Holland type from Messrs. Vickers Limited, Barrow, England, ordered in 1908; two vessels of the American Lake type, completed in 1909; and

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two vessels of the Krupp type, delivered from the Germania Works, Kiel, in 1910. In this way the Austro-Hungarian Navy became possessed of two vessels of each of the three principal designs of under-water warships (with the exception of the Laubeuf and Laurenti types). The naval understanding between the Governments of Austria and Germany placed the latter in possession of the details of the Holland and Lake types purchased by Austria, which in turn obtained the Krupp vessels, and, later, details of the Laurenti type, as acquired by Germany. In this way the navies of the Dual Alliance became possessed of actual samples of four out of the five practical designs for submarines, and there can be little doubt that the Laubeuf, or fifth design, was equally well known to them. The intention was undoubtedly to embody the best features of all these designs in one *exclusively* German-Austrian type of large under-water fighting ship, to be built for the two navies by Messrs. Krupp. The general correctness of this theory was made plain in several conversations which the author had with German submarine experts in July 1913. It may, however, be thought that if such was the aim sufficient details of the different designs could have been obtained without actually purchasing vessels. Although such is theoretically possible, it is not practically the most efficient way, for reasons which any engineer will readily understand. Further, all the vessels acquired with this ulterior motive were known to be powerful fighting craft, and, in themselves, formed valuable additions to the respective navies. Austria purchased the most, because she could justify the course by openly declaring that she "intended, by *practical trial*, to find

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the best design," and had not the necessary machinery and skill to commence building them on her own shores unaided by foreign experience. Whereas all Germany was looking with fanatical confidence, which it would have been dangerous to shake, to the national products of that triune god of war, Krupp—maker of war on land, sea, and air. It was in 1912–13, when all these designs had been carefully tested in practice, that the Germania Yard, Kiel, commenced the construction of the *Improved Krupp type*, resulting in the experimental vessels U21 to U24 (German Navy), and later in the fine submarines of the war era.

The six vessels of the Holland, Krupp, and Lake types, delivered to Austria by 1910, formed the nucleus of the Adriatic flotilla, which was created as an integral part of the Austro-Hungarian Navy in the same year, and had its headquarters at Pola. There were six improved vessels building at Krupp's for the Austrian Navy at the commencement of the European War in August 1914, and vessels of several other types had also been ordered in other foreign countries.

Italy

Italy's first submarine was the *Pullino*, a small experimental vessel, 50 feet in length, designed by Engineer Pullino, R.I.N., which was launched at Spezia in 1892. This submarine was never attached to the Italian fleet, but a second vessel, named the *Delfino*, was constructed two years later, and took her place in the Italian Navy. The original *Delfino* had a submerged displacement of 105 tons, and a speed of 8 knots on the surface and 4 knots when submerged.

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Four other vessels, of the Laurenti type, were launched during 1905–8, which had a submerged displacement of 220 tons. A steady increase in the displacement of each unit or class has marked the development of the Italian submarine flotilla; and about sixty vessels, varying from 220 to 1000 tons, have been constructed since 1905.

JAPAN

Japan commenced the formation of a submarine flotilla in 1904 by the acquisition of five vessels of the American-Holland type. They were constructed at the Fore River Shipyard, Quincy, Mass., and were transported to Japan in sections. Although delivered just previous to the Russo-Japanese War, they were not put together in time to take part in the battle of the Sea of Japan. These first five naval submarines had a submerged displacement of about 105 tons. Two other vessels of the same (but improved) type were constructed in Japan during 1906–7. They were given a submerged displacement of 180 tons. Two others, also of the same type, built by Messrs. Vickers, England, during 1908–9, had a displacement of 300 tons. Since 1904, Japan has built and acquired thirty vessels varying from 120 to 800 tons.

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II

THE CRUISERS OF TO-DAY AND THE BATTLESHIPS OF TO-MORROW

SUMMARISING the main improvements effected in the construction of submarines brought about by the twenty years—"the period from birth to majority"—of experimenting and rapid construction, combined with the actual experience of the powers and limitations of under-water warships gained in the great European War, we find a complete evolution of this type of craft from weak, "handicapped" torpedo-boats into vessels foretelling the large and heavily armed submarine cruisers of the immediate future.

Ruling out the first few vessels launched for each of the great naval powers as purely experimental, both as regards construction and fighting powers, and analysing the principal improvements effected since their definite adoption as part of the fleets in being, a clear understanding is obtained not only of past achievements but also of the future possibilities of submarine warships, if—and it appears certain—the same ratio of progress is maintained.

1. First comes the increase in the displacement of units generally, as without this increase the additional fighting qualities, such as speed, armament, and range, could not have been obtained. In the twenty years under review the submarine has been

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enlarged to fourteen times its original size, and has increased in submerged tonnage 1400 per cent. That is to say, has risen from an average of 100 tons displacement to 1500 tons; and this does not take into consideration the quite modern vessels, having a displacement varying from 1500 to 2000 tons, which are almost equal in size to the smaller types of surface cruisers.

2. In point of speed—always an important factor, as the speed of a fleet must be reckoned as that of its slowest unit—the increase has been from 9 knots to 20 knots on the surface, and from 4 knots to 10 knots when submerged. This shows an advance of well over 100 per cent. in this highly important respect. The advantages accruing to submarines from every increase in their surface, and submerged speeds in actual warfare, will be better understood after an examination of the diagrams illustrating the speed difficulty in submarine attack (see pp. 184–193).

3. The surface endurance of submarines is the measure of their *independent* radius of action, or fuel capacity (heavy oil or petrol), and as such is but little less important than speed. In this respect the improvement has been even more marked. Their range has been increased from 500 knots to 8000 knots at economical speed, giving modern vessels a 1500 per cent. wider range of action. What this means will perhaps be more fully realised when it is stated that a maximum voyage out and home in the older vessels was from Heligoland to the nearest point on the east coast of England; whereas with the increase in the surface endurance, or fuel-carrying capacity, a voyage from Heligoland to the Orkney Islands, and from thence down the west coast of

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Scotland and England *via* the Irish Sea, and back to German waters by way of the English Channel, only demands a little over one-third the fuel carried, thus allowing, *with a margin for contingencies*, a cruise of 3000 miles in total length to be accomplished in the Atlantic also. Taking another example, a modern submarine of large size can easily cross the North Atlantic, or travel from New York to Aspinwall, or Panama to Puget Sound, under her own power without replenishing fuel supplies. With the aid of bases, such as England possesses, the voyage from Europe to Australia can easily be accomplished. A practical illustration of the first of these examples was afforded by the activity of German submarines, for many days at a time, in the Irish Sea, St. George's Channel, and off the U.S. coast, with their base at Heligoland about 3300 miles distant. While an instance of the latter possibility was the voyage in 1913 of the Australian submarines AE1 and AE2 from Barrow, England, to Sydney, N.S.W., Australia —a distance of over 13,000 miles entirely under their own power *and without convoy*, but with the aid of British naval bases for replenishing fuel, food, and other supplies.

4. The surface radius of submarines leads to the question of submerged endurance, which up to the present time has been limited to the amount of electric current for driving the under-water electric engines which could be stored in the batteries.[1] Any increase in the submerged cruising capacity is more a *tactical* than a *strategic* advantage. The submerged endurance of the older vessels was barely

[1] Charged through a dynamo driven by the oil engines used when cruising on the surface.

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100 knots, whereas in modern types it is approximately 400 to 600 knots, an increase of about 500 per cent. The fact that submarines can now cruise in a submerged condition for a distance of over 500 miles must not be taken as implying that they do this without coming to the surface. Travelling at 10 knots they would have to remain under water for fifty hours to accomplish such a journey. Apart from the question of the strain of this journey on the crew, and the condition of the interior of the vessel as regards heat and air, there is the problem of navigation, which would render such a voyage extremely difficult, owing (*a*) to the periscope being useless for navigation at night, and (*b*) to the necessity for taking observations to correct deviation from the true course and ascertaining exact position. A submarine, even in a theatre of war, can usually come to the surface for a short time after darkness has closed over, providing *absolute silence* is observed and a keen look out kept. The main tactical advantage derived from submerged endurance and submerged speed is that the submarine possessing them can during the whole of the daylight hours cruise in a semi-submerged condition, ready to dive below the moment an enemy is sighted, for, as Admiral Sir Cyprian Bridge has said, "When submerged the concealment of the submarine is practically perfect." The submerged speed is of importance, because it is upon this that submarines mostly rely to get sufficiently close to the object of attack to launch a torpedo.

5. In the all-important point of armament the greatest progress has been made. Taking first the torpedo arm: in the older boats only one bow tube,

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with three torpedoes, was carried; modern vessels have a combination of bow, stern, and broadside tubes numbering from four to eight, and fourteen or more torpedoes are carried. In this respect it will be easily seen that one of the older vessels, after a few unsuccessful attacks, was rendered absolutely impotent by lack of ammunition. It has been proved in recent naval fighting that, at most, only one in every three torpedoes discharged from a submarine hits the object aimed at. This, combined with the fact that the torpedo must be "carried" to within at least 1000 yards of the object of attack before being discharged in order to be reasonably sure of hitting the mark, has made it apparent that the torpedo does not offer the best or most reliable weapon of attack, although by its skilful use much destruction can be caused. The difficulty occasioned by the *fixed submerged tubes* of submarines is another disadvantage of the torpedo. The tubes from which the torpedoes are discharged are fitted inside the submarine on a a line with the centre of the boat, and cannot be moved or aimed in any way apart from the boat itself. It therefore becomes necessary for the submarine to be aligned by the steering rudders on the object of attack before the torpedoes can be discharged. In simpler vein, torpedoes can only be fired by a submarine straight ahead or straight astern. Hence a submarine, with a hostile warship coming up on its beam, is compelled to turn and face its opponent (or turn its stern towards her) before delivering an attack.[1] It is to the big naval gun with armour-piercing projectiles of great explosive power that all

[1] A few vessels, which it would be unwise to specify, are now being fitted with movable submerged tubes.

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nations are looking for the primary weapon of attack for submarines, with small guns, torpedoes, and mines as secondary arms. All moderately large submarines are now equipped with one or two 4 or 5 inch quick-firing guns, and one or two small high-angle anti-aircraft guns. The value of these guns on submarines was amply demonstrated by the sinking of many merchantmen by German submarines during the present war, and by the bombardment of Whitehaven and other English towns. It cannot be supposed that the large 2000-ton submarines building are intended solely as torpedo-carriers—for which purpose somewhat smaller vessels in greater numbers would be more effective. Their armament will include heavy naval guns, the calibre of which should not be less than that of the 12-inch weapon already installed in the British submarine M1. The addition of mine-laying tubes to certain types of submarines, by means of which a steadily increasing number of 200-300 lb. explosive mines can be laid while the vessels are cruising below the surface, combined with the provision of heavy guns and many torpedo-tubes, has brought the whole question of submarine warship construction to a point at which a division into classes is necessary. There are *submersible cruisers*, with 6, 9, and 12 inch guns as well as eight torpedo-tubes; *submarine mine-layers*, with twin-laying tubes, 15–20 mines, 5-inch guns, and two torpedo-tubes; *submarine torpedo-boats* of high speed, with two torpedo-tubes, twenty torpedoes, and 4 to 6 inch guns; and *depôt or cargo submarines*, with a carrying capacity of several hundred tons. What the effect of this enormous increase in the armament of submarines will be in future naval warfare generally will be better under-

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stood when the subsequent chapters have been read.

6. One effect of the enormous increase in the size of submarines has been the passing of the purely diving type. "Submarines must, as it were, be prepared to encounter shoals above her and shoals beneath her. She must have a certain stratum of free water between her and the sea-bed, and she must also, when submerged, have a certain stratum of free water between the highest point of her conning-tower and the surface."[1] The second stratum must be rather more in depth than the extreme draft of the ships of the surface force which the submarine assails. The safe depth of the first stratum, *i.e.* that between the keel and the sea-bed, depends in a great degree upon the *length* of the submarine and the *angle* and *speed* of the dive; or, more correctly, the safe angle at which a dive below the surface can be accomplished depends on the depth of water below the keel and the length of the vessel. It will be readily seen that a vessel 200 feet long diving under the surface at an angle of 2 to 2½ degrees requires more sea-room both longitudinally and vertically than a vessel of half that length going down at the same angle and speed. Furthermore, many types of naval submarines are only held below the surface by the action of the passing water on rudders (and hydroplanes). That is to say, they can sink to the awash condition when at a standstill on the surface, but in order to totally submerge must get under way so that the passing water may exert the required downward pressure on the rudders sufficient to cause the submarine to over-

[1] Admiral Sir Cyprian Bridge in *Submarines of the World's Navies*, by Charles W. Domville-Fife.

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come the *reserve buoyancy* and slide completely under. The moment the engines cease and the "way" is taken off the vessel she rises automatically to the surface. From this it will be seen that a submarine must get up a certain speed before it is possible to dive. This necessity creates the problem of what is a safe depth in which to dive. It will be obvious that if 50 feet of water (surface to sea-bed) will allow a vessel of 50 feet in length to dive at an angle of 2 degrees with safety, a much greater depth is required before a vessel 200 feet in length can dive at all. Hence the large size submarine cruisers would become inoperative in anything except deep, or ocean, water. For there are few places in the English Channel or North Sea (for example) which exceed 300 feet in depth, and the coast-line of most countries is surrounded by a broad belt of shoal water, seldom more than 200 feet deep, and often far less. In the older types of submarines the angles of diving and rising averaged from 3 to 4 degrees; as the length and size increased, the angles were reduced to 2½ and 2 degrees, but the danger when diving with long vessels in depths of water, allowing but little margin for miscalculation, has caused most of the naval powers to add forward hydroplanes to their large vessels, thus converting them into more or less *even-keel submergence submarines*. This causes the *slide* of the vessel under the surface to be accomplished on an even keel, and enables the largest size submarines to operate in much more shallow water than would have been possible or safe had they been of the purely diving type.

If submarine construction during the past twenty years has resulted in an all-round increase in size, power, and efficiency of at least one thousand per

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cent., it can safely be assumed that, with the unprecedented experience now gained of actual warfare, the evolution of the submarine will be still more rapid.

The practical application of the new science of submarine warfare is daily rendering more and more hazardous the life of the greatest surface battleship and the smallest merchantman afloat in a zone of war. The success in the stern trial of actual naval warfare which has attended all forms of submarine attack and defence, both with vessels and mines, is proved by the destruction of many hundreds of big surface ships during the four and a half years of the great European War. To answer this assertion with the statement that many submarine attacks have failed, as did those on the battle-cruiser *Princess Mary* in the action off Heligoland, and that a large number of German submarines were sunk, is equivalent to saying that because the application of a recognised rule of war, which has produced victory a hundred times for skilful admirals, has failed on one or more specific occasions, it is a sufficient reason for entirely denying its value. But, as Jomini says: "Should a theory be pronounced absurd because it has only three-fourths of the whole number of chances in its favour?"

The result of modern naval warfare has caused the actual value of the submarine to have advanced enormously in the estimation of all naval powers; and the determination for the acquisition of strong fleets of these under-water craft, not only by the Great Powers, but also by smaller nations whose financial resources prevent them from acquiring fleets of big and costly surface battleships—for it has been proved that none but the very largest, fastest, and

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most heavily armed are of real value—will, in the near future, undoubtedly, be very great.

It is now being admitted by naval experts in all countries that the battleship of the future will be submersible, and in proof of this it may be pointed out that previous to 1901 the surface displacement of submarines barely exceeded 100 tons, in 1905 it had risen to an average of 300 tons, in 1910–11 it had grown to 600 tons, in 1914 to 1200 tons, with corresponding increases in engine-power, speed, armament, range, seaworthiness, habitability, and safety. After the first year of the Great War, with the lessons of actual submarine fighting as a guide, vessels of over 1500 tons displacement were laid down by several powers, including Great Britain and the United States; and the Russian Admiralty called for tenders for the construction of a submarine-cruiser of over 4000 tons displacement.

These large vessels are not intended to act exclusively as torpedo-carriers or mine-layers. A reason, however, at once presents itself in the necessity for increased speed, range of action, and the number of torpedoes with the addition of *heavy naval guns*. Hitherto the rôle of the submarine has been almost exclusively confined to that of the ideal torpedo-carrier, or "daylight torpedo-boat," owing to its ability to perform the same work in the full light of day as that performed under the cover of darkness or fog by the old-fashioned surface torpedo-boat or mine-layer. This brings us to the efficiency of the modern torpedo as a naval arm. Recent warfare has shown that (*a*) in order to be reasonably sure of hitting the mark, a torpedo must be carried to within at least 1000 yards of the object of attack before

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being discharged; (*b*) that only one out of every three or four torpedoes launched from a skilfully manœuvred submarine hits the object aimed at; and (*c*) that the utmost speed (40 knots) of the torpedo must be maintained throughout its course from tube to target, or else the likelihood of the vessel attacked being able to avoid the oncoming torpedo by the skilful use of the helm is more than doubled. Although these facts are indisputable, they do not in any way lessen the value of the torpedo arm in many instances when carried by submarines—as is proved by the torpedoing of many warships in the recent naval operations—but it will, however, be apparent that the era of the torpedo as the only arm of the submarine is rapidly giving place to that of the heavy naval gun on large vessels.

The question of speed, so vitally important to all classes of warships, next demands attention. High speed on the surface and moderate speed when submerged is what is aimed at by all types of modern submarines, the reason for this being that in order to fight it is first necessary to get within firing range—which, for a torpedo-carrier, is approximately 1000 yards. No surface warship would allow a submarine to approach within this range if it could be avoided either by steaming away, manœuvring, or by gun-fire, and, *presuming the submarine to have been sighted*, nothing but equality of speed would enable her to manœuvre sufficiently close to deliver an attack. Even if she was not sighted, the difficulty of a submarine with a speed of 10 to 20 knots getting within 1000 yards of a surface ship travelling at 28 to 35 knots is sufficiently great to cause attention to be focused on an increase of speed for

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the under-water craft of the torpedo-carrying type. In modern naval warfare the supremacy of the engineering over the personal element has caused it to become almost an axiom that the fastest vessel will either secure an advantage of position or destructive power, or else refuse to fight at all. The speed of a submarine when travelling below the surface is a problem of great complexity, as, up to the present, high speed has been found impossible when submerged, owing to the difficulties of navigation and the danger of a sudden deviation from the horizontal course. Some idea of the technical side of the speed difficulty will be gained from a careful study of the diagrams on pp. 184–193. For purely coast and harbour defence the small and fairly fast submarine torpedo-boat is undoubtedly very effective, but in order to take part in actions fought many leagues from a naval base, or in other words to maintain command of the sea, large submarines of wide radius of independent action and of good sea-keeping qualities are essential, and in order that the fighting qualities of such vessels may increase in accordance with their displacement, personnel, and cost, it is necessary that their speed be brought nearer to a degree of equality with that of the big surface ship, their principal objective, and that their armament be augmented so that reliance is not placed on one weapon, limited in numbers, and of very short range.

If these facts—relating (1) to the steady growth of submarines from 100 tons to 2000 tons displacement in 21 years; and (2) the equipment of these vessels with guns of steadily increasing weight and power; (3) the increase of surface speed from 8

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knots to 20 knots, and the necessity for still greater speed; and (4) the necessity for wide radius of action and good sea-keeping qualities—are admitted, as is proved by the ships themselves, then it is, though perhaps unconsciously, admitted that the evolution of the small, slow, and weak submarine torpedo-boat into a large and powerful submersible battleship is actually taking place.

Reviewing this progress as reflected in the literature on the subject, we find Commander M. F. Sueter, R.N. (First Captain of the British naval submarine A1), writing in 1907 that "the building up of a large number of submarines during the last few years has proceeded with methodical regularity. A continuity of ideas has been noticeable in all these designs. . . . This progressive system has made each boat in many respects better than her previous sister."[1] In the *Naval Annual* as far back as 1911 Commander Charles N. Robinson, R.N., stated that, "Side by side with the destroyer, during the same period, and more or less taking its place as the torpedo-carrier of the future, the submarine has also advanced in size and power. In France and Great Britain the development of the submarine has been little short of marvellous. . . . These figures do not convey fully the development in the submarine, for the sea-keeping powers and radius of action of the latest boats (1911) are quite equal to those of destroyers." This, then, was an accomplished fact as far back as 1911.

Admiral Sir Percy Scott, K.C.V.O., C.B., etc., prophesying the mastery of the submarine over

[1] Extract from *Evolution of the Submarine Boat, Mine, and Torpedo.*

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the surface battleship, said, in June 1914 (two months before the opening of the great European War)[1]: "In war-time the scouting aeroplanes will always be high above, on the look out, and the submarines in constant readiness, as are the engines at a fire station. If an enemy is sighted, the gong sounds and the leash of a flotilla of submarines will be slipped. Whether it be night or day, fine or rough, they must go out to search for their quarry; if they find her, she is doomed. Will any battleship expose herself to such a dead certainty of destruction? I say, No. Not only is the open sea unsafe; a battleship is not immune from attack even in a closed harbour; for the so-called protecting-boom at the entrance can easily be blown up. With a flotilla of submarines commanded by dashing young officers, of whom we (British Navy) have plenty, I would undertake to get through any boom into any harbour, and sink or materially damage all the ships in that harbour. If a battleship is not safe either on the high seas or in a harbour, what is the use of a battleship? What we (England) require is an enormous fleet of submarines, airships, and aeroplanes, and a few fast cruisers, provided we can find a place to keep them in safety during war-time. I do not think that the importance of submarines has been fully recognised, neither do I think that it has been realised how completely their advent has revolutionised naval warfare. In my opinion, as the motor vehicle has driven the horse from the road, so has the submarine driven the battleship from the sea."

Mr. James R. Thursfield, the well-known naval writer, states in his admirable book on "Naval War-

[1] See *Daily Mail*, 2nd June 1914.

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fare": "Either the submarine vessel will remain small and therefore weak and lacking in enduring mobility, in which case it can never establish an effective command of the sea, or it will grow indefinitely in size, in which case it will fall under the inexorable stress of the logic which brings us back once more to the battleship." It may be that the battleship of the still distant future will be a submersible battleship. But many exceedingly complex problems of construction and stability will have to be solved before that consummation is reached." When Mr. Thursfield wrote this prediction the largest submarine afloat did not much exceed 400 tons; vessels are now being built of 2000 tons, mounting a 12-inch gun, and the problems of construction and stability have been overcome.

This ends the exposition of the evolution of the submarine and its elements of strength and weakness. The reader is now in possession of all the essential facts, so far as submarines are concerned, for an intelligent understanding of the larger operations of naval war, and the effect produced by the perfection of the submarine on the old theories of sea power, from the strategic manœuvres of surface fleets to those vital problems of national life dealing with oversea commerce and food supply.

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PART III

THE DEVELOPMENT OF THE COUNTER-ATTACK

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I

ANTI-SUBMARINE WARFARE

THE axiom that every new weapon of attack is met by a new method of defence must not be taken either literally or philosophically. There may be, and generally is, a method of defence against every possible form of attack, but it frequently occurs that one or other is inherently the stronger. In fact, when a new weapon, strategic conception, or tactical scheme, is adopted by a naval staff for practical application in war, it is because of its adjudged ability to overcome all known methods of attack or defence, respectively, under the specific or general conditions likely to obtain. Therefore, like so many axioms of war, adopted without due consideration of their true meaning, the one under review is simply another version of the older maxim that necessity is the mother of invention. When applied to a specific weapon, like the submarine, the interpretation too frequently accepted is that a *complete antidote* has or will be found. Hence a feverish anxiety by both press and public was noticeable during the years of the past Great War for some official announcement that this antidote for subsurface vessels had been discovered or devised by the co-operation of naval and scientific brains.

This public anxiety was due to quite legitimate

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causes. The basis of which was an undefined fear of the effect of the submarine on British naval power, and consequently on the food supply of the United Kingdom, but the entreaties for a specific remedy were fostered by a curious misconception of the submarine, and of the theory of war in general. It is not too sweeping an assertion to say that there is no certain antidote which can be relied upon on each and every occasion for any weapon of warfare. Is there a definite answer to the battleship, the tank, the mine, the aeroplane, the torpedo, the destroyer, the monitor, or any of the other appliances for sea or land fighting? To use a parliamentary phrase, the answer is in the negative, but there are many methods of defence or counter-attack, all of which are, however, subject to the chances of war.

The submarine is not a new weapon in the truest sense, any more than the super-Dreadnought battleship. It is merely *the modern stage in the evolution of the warship*—the point when the medium of the surface has ceased to satisfy the requirements of science, and the air and the under-seas are called upon to make up the deficiency. It was not an answer to a specific weapon, like the 15-inch gun—possibly to be met by additional armour—that was called for, but an antidote for a type of ship which, had it been possible of accomplishment, would not only have annihilated the submarine but also every type of surface as well as submerged warship, because the modern submarine is a *combination of the two.* It can attack and travel on both planes.

If, on the other hand, the practical need was for something to render the submerged warship a little

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more vulnerable to the attack of a surface warship, then science provided a variety of weapons, such as the hydrophone, the depth-charge, and special types of ships and mines, nearly all of which were, themselves, of a submarine character, and by their addition to the naval armoury still further widened the gap between the old and the new theory of sea power.

Previous to the epoch-making year 1914 there were no known methods of either finding or attacking a submarine when travelling submerged, but the coming of war and the necessity for such caused the birth of the hydrophone—an instrument which catches and magnifies sounds radiating in the under-seas from the central disturbance caused by the propellers of a submarine, and transmits the direction from which they emanate to listeners on a surface ship. This instrument enables the surface warship to get into fighting touch with the *invisible* submarine, if the latter comes voluntarily, or is compelled by superior tactics, to approach within the range of the hydrophone, which can be represented by a circle drawn round the listening vessel at a radius therefrom of three nautical miles.

At this point in anti-submarine tactics another weapon provided by modern science—the depth charge—comes into action. The approximate position of a submarine in the narrow circle of sea around having been discovered by the aid of the hydrophone, the attacking surface ship turns her bow in the direction of the sound and moves swiftly ahead until, by rough estimate, she has placed herself over the top of the submarine. A succession of powerful depth-charges, or bombs arranged to explode *when they have sunk to a given depth below the surface*,

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are then released. The hope being that one or other of them will either drop on the deck of the under-water vessel or else explode sufficiently close (within 70 feet) to cause her serious injury.

The co-operation between the hydrophone and the depth-charge is a natural one. The former instrument finds the submarine if she is within three miles of the attacking surface ship, and the latter weapon gives the *coup de grâce* if it can be dropped sufficiently close.

This, then, may be termed the strength of the hydrophone attack; let us now examine its weakness, notwithstanding quite a number of successes scored in modern naval warfare. The hydrophone faithfully reproduces not only the sounds made by the engines and propellers of a submarine, but also *all sounds* passing through the water, which, be it remembered, is a far better conductor of sound than air. On a rough day the instrument is practically useless, near to rocks or sand-banks the water noises drown all other sounds. The ship using the instrument must stop her own engines before listening, otherwise the noise they make will deaden any other more distant sound. During daylight and clear weather it is, of course, possible to verify the nature of the sounds coming up from the depths over the wires of the hydrophone. If the noise of engines can be heard and nothing is visible on the surface around, then it must emanate from a submarine; but at night, in fog, or during daylight in a crowded waterway, it is extremely difficult for even a highly trained ear to distinguish from the sound alone whether a surface ship or a submarine is in the vicinity, and any movement of the listening ship to investigate deafens the instru-

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ment until the vessel again comes to a standstill. Finally, the hydrophone is as much use when fitted in a submarine (all U. and U-C. boats were equipped with a number of these instruments) as it is in a surface ship, which means that if, by its aid, the submarine can sometimes be discovered, she can, by using a similar instrument, also be warned herself of the approach of surface ships. At least 2000 patrol ships were fitted with hydrophones and depth-charges and scoured the seas of the mine-enclosed danger zone in search of some 100–150 German submarines, destroying by this means about 40–50 of them in just over four years.

From this it will be apparent that although both these weapons enable surface ships to attack submarines with a chance of success they fall very far short of the expected antidote. The same must be said of special mines, modified-sweeps, indicator-nets, barrages, mystery ships, and all appliances so far devised. Each is a form of attack or defence against under-water craft, especially deep-laid mine-fields and mystery ships, but none of them come within measurable distance of destroying, or even seriously impairing, the great strategic and tactical advantage derived by a warship's ability to submerge.[1]

The late Field-Marshal Earl Roberts, in a conversation with the author, once expressed the opinion that many people, even those versed in the art of war, are prone unwittingly to exaggerate the effect

[1] For a detailed account of the ships, weapons, and operations employed in anti-submarine warfare, see *Anti-Submarine Warfare*, by Charles Domville-Fife (Messrs. Seeley, Service & Co. Ltd., London, and Messrs. Lippincott, New York).

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of the particular arm or plan of campaign which they, themselves, have employed successfully on one or more *favourable* occasions; unconsciously dismissing from their minds the many times on which the same weapons or plans have, in their own or in others' hands, failed under *less favourable* conditions to achieve even a measure of success.

Applying this to sea war we find a gunnery officer, a torpedo expert, a navigator, or the commander of a cruiser, destroyer, submarine, or mystery ship, or patrol boat, each conceiving a given operation or form of warfare primarily from the standpoint of his own particular arm or type of ship, rendering much that may be said here regarding the respective values of the weapons used in anti-submarine warfare highly debateable. The same must also be said of the different classes of ships, but the truth underlying all assertions is that no specific weapon or type of vessel yet devised is a sovereign remedy for submarine depredations. Each has a distinct fighting value, which by combined operations *on a very large scale* enables a surface fleet to put up a stern fight against an under-water opponent.

A surface fleet must, however, be able to place on the seas of the principal danger zones at least ten surface ships for every submarine available to the enemy, exclusive of those fast vessels required for anti-submarine operations to protect a big surface war fleet, and to employ mine-fields of vast dimensions in order to limit the areas of sea forming the danger zones to the smallest extent geographically possible. It was not until the North Sea was enclosed by some of the largest mine-fields ever employed in naval warfare, and the water between and on the circum-

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ference of these fields was patrolled by nearly 1500 armed vessels, that the Allied navies can truthfully be said to have definitely limited the activities of the 100–150 U-boats issuing from their *only* bases on the German and Flanders littoral. To convert this limitation of the hostile submarine power into a complete defeat with the aid of 180 disguised warships (mystery ships), 500 patrol launches (19 knots, 13-pounder), 1000 trawlers (10 knots, 12-pounder), 1000 drifters (8–10 knots, 6 or 12-pounder), and about 100 fast motor boats (40 knots, one torpedo), formed into a network of patrols and operating from over fifty fully-equipped shore bases, occupied three years. It is therefore very unwise for any maritime nation to blind itself, because of the defeat of the comparatively small German flotilla, to what will be required in future naval warfare to check the depredations of, say, 1000 cruiser-submarines operating from bases *scattered over the seven seas.*

So far we have dealt with the known methods of counter-attack, there are, however, purely defensive measures which can be advantageously adopted by surface ships. The principal being the addition of "blisters" to the hulls of big vessels. A blister is nothing more or less than a false hull built in the form of a "blister" round the real shell of the ship. The idea being to form a cushion, between the outer plates of the blister and the inner plates of the real hull, of sufficient flexibility and thickness to nullify the effect of the explosion of a mine or torpedo. In both theory and practice this is an excellent device, which achieved considerable success on the British monitors used for bombarding the Belgian coast. It suffers from several serious disadvantages, however. The

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most important of which is the great loss of speed occasioned to the vessel fitted with this somewhat cumbersome projection from the real hull. Should this loss of speed be overcome by an increase in engine power—out of proportion to the present ratio of power to weight and space—then it, undoubtedly, will form a surface warship's principal means of defence against torpedo and mine attack. It is, however, nothing more than a form of armour against the *present* explosive power of the torpedo and the mine, and makes no allowance for a considerable increase in that power—much more easily accomplished than a still further extension of the size of the blister to meet a greater explosive force. In this way it would appear to follow the law of the naval gun and corresponding armour plate, but a moment's reflection will show that it is a much more difficult proposition.

The blister is no answer to the modern submarine, although it may save a number of warships from sinking after a torpedo or mine attack. It cannot be fitted economically to any merchantman owing to the loss of power and speed occasioned in time of peace. It has been sought to meet this difficulty by filling the hulls of converted merchantmen in time of war with short length of timber in order to render them equally as unsinkable when damaged. This is yet another method of defence, but it can only be used by merchant ships engaged as armed patrol or mystery ships, and not as food or munition carriers, for obvious reasons.

Most important of all is the fact that modern submarines do not rely upon either torpedoes or mines for their offensive power. The addition of 9-inch

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and 12-inch guns is rendering them the equal of, at least, the cruiser even when on the surface. From which it will be apparent that they have a wonderful choice of position for attack. If a hostile surface warship, elaborately defended against torpedo attack, is the target, then it becomes simply a question of the power, range, and accuracy of their respective batteries. Should the submarine be the weakest in this respect she will refuse the fight by submerging and wait for a more favourable opportunity. If the target is a big warship comparatively undefended against torpedo attack, then it resolves itself into a question of surprise attack, tactics, or speed. Should the submarine, with her comparatively slow submerged speed, be able to get within torpedo range, then the chances of war are distinctly against the surface ship, and if the submarine finds herself unable to attain this position then there will be no fight. Should International Law find itself unable to protect merchant ships, the submarine will cripple the oversea commerce of her enemy within a few months of the opening of hostilities, unless the building resources of the latter are out of all proportion to the number of sub-surface vessels available to the former. In the great European War nearly all merchant vessels which were attacked by submarines and succeeded in escaping were enabled to do so by their superior speed and the armament they possessed for beating off surface attack. With the adoption of 12-inch guns on submarines this will only be possible in very exceptional circumstances.

The provision of an anti-submarine patrol drawn from the numerous smaller craft of a nation's mercantile marine will also be rendered difficult. In the

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great European War over 2500 ships were employed in the *limited* danger zones of the North Sea, Mediterranean, Adriatic, Irish Sea, English Channel, Arctic Ocean, and Eastern Atlantic. These patrols and mine-sweepers were composed of a few liners and ocean tramps armed with 6-inch and 4-inch guns, and about 2200 yachts, trawlers, drifters, motor launches, coastal motor boats, and sailing schooners, armed with 13, 12, 6, and 3 pounder guns and depth-charges. Owing to their small size these latter ships were unable to carry heavier guns than those mounted, which, even in the past war, rendered their work hazardous in the face of hostile submarines armed with 5-inch weapons, unless they operated in twos, threes, or flotillas of five, which naturally decreased the area any given number could be relied upon to effectively patrol. A curious fact which rendered the German submarines less formidable than they might have proved was their reluctance to fight even a less heavily armed vessel on the surface. This was due to the surprises they received when they unknowingly attacked a mystery ship.

In a future war, with cruiser-submarines operating from bases on several seas, and armed with one or more 12-inch guns with a secondary battery of 5-inch weapons and torpedo tubes, a patrol of trawlers or of small and comparatively weakly armed surface ships would be not only ineffectual but suicidal, and if small ships are ruled out, where will the thousands of big ships, required to maintain an efficient patrol, be obtained from? The answer may be that the submarines of one nation can be used against those of another. This is partly true, but neither will be able to ensure the command of the surface owing to

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the complete overthrow of all the canons of sea power.

This brings us to what is at present the final and undoubtedly the best method of anti-submarine warfare—the use of deep-laid mines in very large numbers and the provision of powerful surface flotillas to operate above them. With this system the idea is to lay the mines in vast fields at a depth which will enable surface craft to ride safely over the top of them. In this way a hostile submarine—irrespective of size and gun-power—comes unknowingly into a mined zone. She observes a fleet of fast and heavily armed ships and decides to submerge in order to avoid them. If, on the other hand, she elects to remain on the surface she will in all probability be seen and destroyed by the combined gun-power of her surface opponents. Should she dive below the surface, however, she will meet instant destruction among the deep-laid mines. In most cases, being unaware of the presence of mines, she will adopt the latter course. About fifteen German submarines were destroyed in this way by the Dover to Cape Gris-Nez mine barrage in less than nine months.

The weakness of this method is the possibility of submarines becoming aware of the position of the mine-field and crossing it on the surface at night. From Dover to the French coast this was guarded against by a line of moored ships capable of riding out the worst storm and provided with searchlights. Powerful surface flotillas operated between the line to Cape Gris-Nez, and another similar line seven miles farther to the westward, and the deep-laid mines guarded the seas beneath.

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This mine-barrage system is ideal for enclosing narrow seas, but could not be put into operation against nations with a long seaboard, such as England, America, France, or Japan, or against those with a large number of colonial submarine bases.

This exhausts the principal methods at present evolved for anti-submarine attack and defence. The future discoveries of science will undoubtedly tend to redress the balance between the surface and sub-surface warship. Several new methods are already nearing perfection, but that they will not prove the complete antidote is a logical conclusion, because the two types of warships are rapidly nearing the point of unification. The submarines of the future will be submersible battleships, cruisers, mine-layers, and torpedo-boats, all of which will be equally powerful *on or under* the surface and will possess the great strategic and tactical advantage of being able to attain any position without serious hindrance from the fleets of their opponents. Their most deadly enemies will be the heavily armed super-seaplane and the mine. The great disadvantage of the aerial warship is its present inability to contend successfully against the heavy winds which sweep the oceans. Whatever science may have in store it will, however, be apparent that the whole theory and practice of sea power will have to be reconstructed to meet the changed conditions.

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PART IV

THE INFLUENCE OF THE SUBMARINE ON NAVAL STRATEGY AND THE OPERATIONS OF WAR

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I

EFFECT OF THE SUBMARINE ON NAVAL STRATEGY

HAVING in mind Jomini's dictum that changes in weapons *affect the practice but not the principles* of naval war we find it advisable, first, to say something of the permanent principles of sea strategy before attempting to show the great changes in their application caused by the development of the submarine science and arms. These changes shake to their foundations the theories of naval war, casting off many of the superannuated principles that grew up from the introduction of steam, and leaving bare the simple bases on which the new schools of naval thought must build the edifice of modern sea strategy and power.

The owning and control of a comparatively large and efficient fleet with well-chosen bases is the main element of naval power, and the best way to scientifically use that power constitutes naval strategy, which it must be remembered is played on a larger board than land strategy, is geographically more far reaching, and encounters fewer obstacles; those which it does encounter are, however, more impassable. The influence of sea power on national life is being demonstrated daily, almost hourly, and all nations are realising more forcibly than ever before that "Le trident de Neptune est le sceptre du monde."

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If, then, naval strategy is the use of naval power, which, in itself, is the primary factor in national greatness, freedom, and security, the importance of its study in the ever-changing light of modern conditions is second only to that of moral and physical science, which is the basis of "fitness to win," the life-blood of strategy, tactics, and all else in war—closely interwoven with the greater doctrine which rules the universe.

Naval strategy must never be confused with tactics, which cover all the evolutions for position of fleets, squadrons, flotillas, and individual ships, *when in action*, but strategy means the larger operations of war which lead to the decisive encounter. Strategy may be said to end when an action begins; it may be renewed after the battle, but does not concern itself with the tactics of the fight. "Based as naval strategy is, upon fundamental truths, which, when correctly formulated, are rightly called principles, these truths, when ascertained, are in themselves unchangeable; but it by no means follows that in elucidation and restatement, or by experience in war, new light may not be shed upon the principles, and new methods introduced into their application. This will constitute development, alike in the practice of naval strategy and in that statement of its laws and principles which we call theory. The physical sciences supply us here with apt analogies. The laws governing them, for example electricity, are immutable; but in the application of the laws the lifetime of a generation testifies how great modification and progress are possible."[1] This quotation from Admiral Mahan leads to the adoption of his diagnosis of the four main elements of

[1] *Naval Strategy*, by Admiral Mahan.

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strategy. These are, *concentration*, *central position*, *interior lines*, and *communications*. To these, however, must be added such accessory subjects as *home defence*, *foreign relations*, *geographical considerations*, and *national characteristics*. Of the latter Marshal von der Goltz has said that, "Whoever writes on strategy and tactics ought not in his theories to neglect the point of view of his own people. He should give us a national strategy, a national tactics."

Beginning, then, with *concentration*, which is the massing of a force; *central position*, which is the interposition of that force between the divided bodies of an enemy or enemies; *interior lines*, which is the elongation of a "central position," enabling sustained intervention between the divided bodies of an enemy, conferring the power to concentrate superior forces against one while checking the onslaught of the other with possibly inferior forces; and *communications*, which are the routes by which a fleet or army is supplied with the necessities of life and war, and is kept in active communication with a base or centre of national power. Examples of these strategic definitions must be given here in order that a clear understanding may be obtained of the various "positions," which will afterwards be "attacked" with the aid of submarines, mines, and torpedoes.

The timely concentration of the British Grand Fleet on the morning previous to the outbreak of the great European War (3rd August 1914) prevented the already concentrated German high-sea fleet from making a sudden move against any weak or divided portion of the British fleet, and achieved besides four great victories: (1) the strangulation of German oversea commerce, because the fleet of the Fatherland,

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which might have been superior to one or more portions of a scattered British fleet, was markedly inferior to it when concentrated, and therefore dare not venture out from behind its fortified bases to protect the commerce it had been constructed to defend; (2) secured the freedom of the seas for the Allies; (3) prevented raids on the coasts of England and France; and (4) ensured the safe transport of the Allied land forces to and from the various centres of Imperial strength and the theatres of war.

As a practical example of the lack of concentration and its results we have only to recall the division of the Russian fleet during the Russo-Japanese War, in which the Far Eastern fleet was divided from the Baltic fleet by many thousand miles of sea when war broke out. The Japanese fleet was concentrated in home waters and immediately took up the *central position* between the two divided Russian fleets, which combined would have been superior in force to the whole Japanese Navy, but when divided each half was inferior to the concentrated navy of Japan. Togo successfully occupied the central position and was able to throw nearly all his force against whichever section of the divided Russian Navy was first brought to battle. The Port Arthur division waited for the Baltic fleet to come to its assistance, with the idea of forcing a junction; but the fall of the fortress of Port Arthur from the land side prevented any attempt being made to accomplish this, which was, at best, only a forlorn hope. Both fleets were thus vanquished in detail. There were, of course, complicating factors, such as the division of the Far Eastern fleet itself between Port Arthur and Vladivostok, which only tended to make matters worse for the Russians, as

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both divisions were separately defeated by the centralised Japanese force.

From this it will be seen that a fleet which, on the outbreak of war, is able to mobilise and concentrate first often gains an important advantage, and seeks to make use of that advantage by endeavouring to place itself between the still separated divisions of the enemy's fleet, or, in strategic terms, to secure a central position. This brings us to what is, perhaps, the first problem in the influence of submarines on naval strategy.

It will be patent that no surface fleet could with any degree of certainty prevent the junction of two submarine fleets. This has been amply demonstrated by the successful submarine sorties from Heligoland, in which German submarines have repeatedly passed unobserved the large British patrol flotillas in the North Sea; by the junction of German submarines with the Turkish fleet after passing successfully the Allied fleets centralised in the North Sea, Channel, and Mediterranean, including the passage of such narrow and well-defended waterways as the Straits of Dover and the Straits of Gibraltar; by the junction of a British submarine flotilla with the Russian Baltic fleet, notwithstanding the intervening German fleet and base at Kiel and the narrow waterways of the "International Passage."

In applying the principle that no surface fleet can with reasonable certainty prevent the junction or concentration of two or more submarine fleets, the question may be asked: Had the Port Arthur division been composed entirely of modern submersible warships, could Togo have taken any *absolutely reli-*

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able means to have prevented its junction with the Russian Baltic fleet on the arrival of the latter in Far Eastern waters, or could he have prevented the Vladivostok squadron from joining forces with the Port Arthur division? In view of what has occurred in more recent naval fighting, such as the repeated penetration of the Dardanelles defences by British submarines, the sorties of Austrian submarines from blockaded Pola, and the repeated sorties of German flotillas from Heligoland, notwithstanding the rigorous preventive measures adopted by the British Navy, it is quite safe to assert, with the assurance which facts give to words, that he could not. Chance, combination of circumstances, or lack of skill or initiative, on the part of the Russian crews, might have played into the hands of the Japanese, but there were no reliable means of preventing such a union of forces had they possessed the great strategic and tactical advantage of ability to submerge. Had this been the case, however, no blockade of Port Arthur would have been possible, as the Japanese had not enough ships to be able to risk them in a position constantly exposed to submarine attack. Further discussion of this and other points raised by the example of the influence of submarines on concentration, central position, and interior lines, must be left for future pages as it encroaches on the greater question of the *conversion of inferior into superior force*, blockades, etc.

It now becomes necessary to reverse the presupposed position, and to analyse the effect of submarines from that standpoint. In other words, if a surface fleet cannot prevent the junction of submarine fleets, can a submarine fleet prevent the junction of

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surface fleets? This brings us back to the survival of the old principle of naval strategy. If the submarine fleet is sufficiently numerous and can obtain a central position, it could, in all probability, prevent the junction of two surface fleets, or, at least, inflict such damage on one or both as would almost nullify the effect of a junction. Assuming that England had found it necessary during the first year of the Great War to recall the fleet in the Mediterranean for service with the Grand Fleet in the North Sea, and that a large German submarine fleet (100 vessels) was lying in a central position, say off Gibraltar. The loss sustained by the weak British Mediterranean fleet in getting past the interposing hostile submarines and their mine-fields would either have made a junction impossible, or else have weakened the Mediterranean Force to such an extent as to render impossible of accomplishment the purpose for which it was so necessary that the two surface fleets should be joined. If, on the other hand, natural features assisted the submarines, such as the possession of the Gibraltar Base, a junction between the two surface fleets would be impossible. Imagine, for instance, the German and Austrian fleets attempting to combine with powerful hostile submarine fleets in the Channel and Mediterranean, or the United States fleet attempting the passage from the Atlantic to the Pacific by way of the Panama Canal, with 200 hostile submarines in the Caribbean Sea.

The influence of the submarine on the application of the principle known as "interior lines" is similar to what has just been shown to be its influence on the theory of the "central position." The best example of this can be obtained from land warfare. The

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German position during the year 1915 was an excellent example of an army acting on interior lines. The Germans and Austrians by virtue of their geographical position occupied the central line, and, by elongating it with the aid of Turkey and Bulgaria, effectively interposed their armies between the Allied line in the West and the Russian line in the East. This gave them the power to concentrate against either while holding the other in check with a just sufficient force. This not only enabled them to use their military power to the utmost advantage, but also secured their lines of communication with the centres of national strength. So long as Liége, Antwerp, and Namur held out, however, no material advance towards Paris was possible, as these fortresses, themselves acting on interior lines, threatened the German lines of communication. In a similar manner the Port Arthur fleet, while it remained intact, threatened the Japanese lines of communication between Japan and Manchuria. It should, however, be pointed out that the military value of a position lies not in the position itself but in the use which is made of it. As an instance of this, we have the fact that the Port Arthur fleet made no effort to exploit its strategic position, the reason being that it was always confronted by a superior force which it could not elude. Passing over the theory that it was the duty of a fleet so placed, knowing that the enemy had no reserve of ships, or second line, to fight a desperate action in order to so weaken the opposing hostile forces as to render them in no condition to meet the main or Baltic fleet, which was approaching the theatre of war, it is evident that had the Port Arthur fleet been composed of submarines the

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Japanese lines of communication would have been continually attacked, because the superiority of the Japanese blockading fleet would have been nullified by the ability of the Port Arthur submarines to elude it.

It may be said that in assuming one side to possess submarines only, and the other surface ships only, the comparison is not fair, but it should be borne in mind that submarines cannot fight submarines when submerged, except under most unusual circumstances, one submarine being practically unable to see the other, and both running the risk of collision. On the surface they can, of course, engage, especially since the provision of guns of steadily increasing power in this type of vessel, but this in no way decreases the ability of one submarine fleet to avoid action with another by submerging itself.

It will have become apparent that the ability of the submarine to travel submerged throughout the daylight hours, and so to pass under hostile fleets and patrols, or in other words to manœuvre almost unhindered by the armed forces opposed to her, has given to this type of warship a strategic advantage of the first magnitude, independent of the tactical efficiency derived from the important faculty of carrying out a surprise attack. This strategic advantage is of primary importance, as it is the reason why this type of warship must completely revolutionise the older theories of sea power and naval strategy, which were necessarily based on the assumption that hostilities could only be carried out on the one plane—the surface—and that under all normal conditions and equality of skill one ship or fleet would be visible to another. Neither of these

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essential conditions now apply. A submarine fleet can operate under the surface plane, and often remains invisible to the hostile surface fleet up to the moment of attack, as was the case in the German submarine attack on a cruiser patrol in the North Sea on 22nd September 1914, which resulted in the loss of the British cruisers *Aboukir*, *Cressy*, and *Hogue*, armoured cruisers of 12,000 tons displacement. An extract from the report of Commander B. W. L. Nicholson, R.N., of H.M.S. *Cressy*, to the British Admiralty proves conclusively the sudden and unforeseen nature of this attack, and the close range to which the submarines were able to approach unobserved. He says:

"Whilst on patrol duty *Aboukir* was struck at about 6.25 a.m. on starboard beam. *Hogue* and *Cressy* closed and took up position, *Hogue* ahead of *Aboukir* and *Cressy* about 400 yards on port beam.

"As soon as it was seen that *Aboukir* was in danger of sinking all boats were sent away from *Cressy* and picket boat was hoisted out without steam up; when cutters full of *Aboukir's* men were returning to *Cressy*, *Hogue* was struck, apparently under aft 9·2-inch magazine, as a very heavy explosion took place immediately after the first explosion. Almost directly after *Hogue* was hit we observed a periscope on our port bow about 300 yards off. Fire was immediately opened, and engines put full speed ahead with intention of running her down. Our gunner, Mr. Dogherty, positively asserts that he hit the periscope and that the submarine then showed her conning-tower, which he struck, and the submarine

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sank. An officer standing alongside the gunner thinks that the shell struck only floating timber, of which there was much about, but it was evidently the impression of the men on deck, who cheered and clapped heartily, that the submarine had been hit. This submarine did not fire a torpedo at *Cressy*.

"Captain Johnson then manœuvred the ship so as to render assistance to crews of *Hogue* and *Aboukir*. About five minutes later another periscope was seen on our starboard quarter. Fire was opened, the track of the torpedo she fired at range of 500 to 600 yards was plainly visible, and it struck us, starboard side, just before the after bridge; the ship listed about 10 degrees to starboard and remained steady—time 7.15 a.m. All watertight doors, dead-lights, and scuttles had been securely closed before the torpedo struck ship. All mess stools and tables, shores, and all available timber below and on deck had been previously got up and thrown over the side for saving of life. A second torpedo fired by the same submarine missed and passed about 20 feet astern. About a quarter of an hour after the first torpedo had hit, a third torpedo, fired from a submarine just before starboard beam, hit us in No. 5 boiler-room—time 7.30 a.m. The ship then began to heel rapidly, and finally turned keel up, remaining so for about 20 minutes before she finally sank at 7.55 a.m.; a large number of men were saved by the casting adrift of a pattern 3 target; the steam pinnace floated out of her crutches, but filled and sank.

"The second torpedo which struck *Cressy* passed over sinking hull of *Aboukir*, narrowly missing it. It is possible that the same submarine fired all three torpedoes at *Cressy*."

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From this single instance will be seen the truth of the statement previously made that a submarine fleet often remains invisible to the opposing surface fleet up to the very moment of attack—thus conceding not only the tactical faculty of a surprise attack but also the strategic advantage of being able to manœuvre and take up positions under almost all conditions quite unknown to the enemy. This brings us to the final problem in the influence of the submarine on the *elements* of naval strategy, viz. the lines of communication.

Admiral Mahan has said that "communications dominate war," and that "the line of communications is doubly of value because it usually represents also the line of retreat." "In the matter of communications free supplies and open retreat are two essentials to the safety of an army or of a fleet." It will become an axiom of naval war that in face of a skilful enemy well supplied with large submarines the lines of communication of a surface fleet are never safe. As these lines increase in length, pass through narrow seas or channels, close to hostile coasts, or cease to be guarded by vast numbers of fast destroyers, the weak spots will be found and exploited, resulting in great losses of personnel and material, and the hampering of the movements of the big surface fleet depending on them. To a fleet at sea, fuel, ammunition, and food must be continually supplied from the base or seat of national power. In retreats along the lines of communication the same hampering influence will be made manifest, but when several lines of retreat are open to the surface fleet, each terminating at a well-defended base, the danger from under-water attack will be minimised. Sub-

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marines, themselves, can be employed to guard lines of communication against surface ships, but being unable to see, or attack with superiority, under-water opponents they cannot prevent hostile submarines from raiding communications or lines of supply. They can, however, cover very effectively the retreat of their own surface fleet or squadrons. An example of this was afforded during the action between British and German cruisers off the Dogger Bank in January 1915, which resulted in a British naval victory and the retreat of the unsunk German vessels along their lines of communication with Heligoland. According to Rear-Admiral Hipper it was to obtain the support of their submarines lying in the rear that the German vessels retreated. Although this defence is untenable, as the German squadron was defeated and had lost several vessels, Sir David Beatty has stated that the presence of mines and submarines was one of the causes for the discontinuance of the hitherto highly successful action. It was evidently the menace of a strong under-water attack on the British pursuing squadron that compelled it for prudence' sake—and considering the damaged condition of one of its principal units, H.M.S. *Lion*—to allow the crippled German vessels to escape back to their base, thus preventing them from suffering an annihilating defeat.[1]

An example from recent operations of the ability of submarines, even under the most difficult conditions, to attack an enemy's lines of communication was afforded by the activities of British submarines in the Sea of Marmora while the Dardanelles were still held

[1] The masterly conduct of the British operations in this action is worthy of close study.

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by the Turkish forces. These vessels penetrated the elaborate surface and submarine defences of the straits, which at a point known as "The Narrows" are only a mile in breadth. The average depth of water is about 150 to 200 feet. The submarines on their 10-mile advance through the danger zone of the straits had to pass through several mine-fields, and run the gauntlet of patrol boats, nets, coast-batteries, shore torpedo stations, and submerged entanglements, while hampered by very strong and dangerous currents. The feat of passing through the Dardanelles into the Sea of Marmora was repeatedly accomplished by British submarines, and Turkish warships, transports, and supply ships, on the lines of communication of the Turkish army, were destroyed in this almost land-locked sea. In addition, a party from one submarine landed and blew up a section of a strategic railway line, while another vessel shelled several towns and batteries on the Marmora littoral. Had these submarines been provided with 9-inch and 12-inch guns, instead of the small 14-pounders, the fate of Constantinople would have been settled early in the war. England's line of food supply from America was menaced for many months by German submarines, which would have been more successful had they been in the far greater numbers which will, doubtless, be employed in future naval warfare. Russian and British submarines were employed to guard the entrance to the Gulf of Riga, and several German warships were sunk by them during the efforts to force the passage of the gulf, which flanked the German advance into Central Russia. The sea outflanks all land operations.

This vulnerability of all lines of sea communication

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to submarine attack does not destroy the principles of naval strategy relating to the security of such lines, but emphasises the necessity of a surface fleet acting offensively from a given coast being provided with *several* lines of communication, each having its terminus at a well-equipped and fortified base capable of sheltering a retreating fleet. This prevents the submarines of the enemy concentrating on one line. The further these lines are apart at their termini the less will be the risk of a serious interruption of communications, the danger from submarine attack being lessened in proportion to the number of lines and bases available with the destroyers to guard them compared with the average distance of these lines from the naval bases of the enemy and the number of hostile submarines available for raids on communications.

A maritime nation whose *vital* lines of supply are seriously interrupted by hostile submarines would do well to set afloat all the worthless hulls available, arming them when possible, but reducing the number of hands to a minimum. These should cruise on the lines of communication. The temptation of the hostile submarines to sink the first available ship will in most cases, especially during the first few months of war, be too great to be resisted, and thus many valuable ships and cargoes, temporarily diverted from the usual route, can be saved at the cost of a few worthless empty vessels. The arming of such decoys enables them (1) to strike should the opportunity occur, and (2) prevents the hostile submarines economising ammunition or torpedoes by boarding the decoys and destroying them with a small mine or bomb. It is quite reasonable to assume that a skilfully manœuvred

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decoy might cause the attacking submarine to waste several torpedoes or many shells, and that in every twelve attacks one submarine might be destroyed.

The provision of several lines of communication for a fleet is merely one way of applying the old principle summed up as follows by the great Napoleon: "The art of war consists in the dissemination of force in order to subsist, with due regard to concentration in order to fight."

Having shown the influence of the submarine on the elements of naval strategy we have now to examine its relations to *home defence*, *foreign relations*, *geographical features*, and *national characteristics*, which, although exterior to the actual science of naval strategy, nevertheless have a powerful influence on its employment and direction. Dealing first with home defence, we find that almost every seacoast town in the world is more or less open to bombardment by submarines. The shelling of Whitehaven, on the Lancashire coast of England, by a U-boat in 1915, was the forerunner of what will become a common practice *by the unscrupulous* in future naval war. That the damage done to this town was not great is due solely to two factors: (1) the bombardment was carried on by only one submarine for a very short period, and (2) the one or two guns used were only 28-pounders. Had this vessel been armed with the 9-inch or 12-inch weapons of later vessels the damage caused would have been considerable, and had more than one vessel so armed taken part in the bombardment it would not have taken long to reduce Whitehaven to ruins.

It may be said that this is assuming too much, but

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if the previous chapters, tracing the development of the submarine, have been carefully studied it will be seen that instead of having even the speculative element of "intelligent anticipation" it is well within *the immediate range of practical constructive development.*

If, then, seacoast towns are liable to sudden bombardment from which surface fleets and patrols cannot be expected always to guard them, submarine mines will probably play a much greater part in coast defence than has hitherto been the case; and it might be well for each town to have its corps of specially trained submarine engineers. All such corps would, of course, act on a prearranged plan under naval control. During the German naval raids on the English east coast in the great European War the demand for local protection was very insistent, and might have hampered the larger naval operations by restricting an unduly large surface fleet to purely coast-defence work. This demand for local protection was merely a repetition of history, for in the Spanish-American War the same cry from the Atlantic seaboard of the United States caused the naval authorities to float several old monitors for this purpose, but in that case the alarm was caused not by actual bombardment or the fear of heavily-armed submarines, but by mythical torpedo-boats.

Heavily-armed submarines in sufficient numbers would be an effective coast defence against raids by surface warships, such as that on Scarborough and the Hartlepools; and mines in large numbers and scientifically laid would have a deterrent effect on submarine raids, but might not altogether prevent them.

The vulnerability of ocean communications to submarine attack must cause nations like Great

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Britain to concentrate their attention in time of peace on the provision of adequate food and ammunition supplies for a probable period of war, as never again will the control of the seas and under-seas be so effectively maintained as to preclude the possibility of serious interruptions on the lines of supply by large and heavily-armed hostile submarines. More will be said regarding this vital matter in future chapters.

Turning to the question of *foreign relations*, it is apparent that the influence of the submarine warship is already beginning to make itself felt. Germany gave both Turkey and Bulgaria a flotilla of submarines to assist in the defence of their coasts, thus using these comparatively inexpensive vessels as part of a bribe for an alliance. To a small nation with an undefended seaboard exposed to attack such a policy by large naval powers will probably often be necessary or advisable to aid military operations. A famous statesman once said that the weight of a nation's foreign policy was measured by the number of bayonets ready to support it, and few will deny that the influence of the British Empire in the councils of the world is measured by the power and range of her fleets. Russia had a larger fleet than Japan in the war of 1905, but it was not a modern one, and was geographically at a disadvantage; in consequence, well-informed international opinion expected the victory of Japan. In a like manner will the foreign policy of the future be influenced by the possession of superior strength in *modern* arms; and the control of vast numbers of large submarine fighting ships will be an important item in the reckoning, especially where geographical conditions favour their advantageous employment, as, for instance, in the

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Mediterranean, Caribbean Sea, the Baltic, the English Channel, North Sea, Sea of Japan, Bay of Bengal, etc. The influence of small submarines on river warfare will also make itself felt before long. In the War of Secession the Mississippi forts were conquered directly Farragut's fleet had passed above them and severed their lines of communication. Submarines can be used for similar purposes on many fluvial highways of the world.

To state that the nation which possesses the largest number of well-chosen naval bases will be best able to employ submarines is merely to apply the axiom of the Archduke Charles, that "the possession of the strategic points decides the success of the operations of war," but it also illustrates the influence of geographical features on the conduct of submarine warfare. A narrow strait or channel can be more ably defended by a flotilla of powerful submarines, aided by mines, than by a fleet of battleships, because (1) the narrowness of the waterway prevents the hostile fleet from evading the waiting submarines and of deploying to avoid their attack; (2) a surface-defending fleet of big ships would not have the sea-room required to manœuvre for position or to deploy for action; and (3) because narrow seas lend themselves to submarine and mine "traps" for a hostile surface fleet endeavouring to pass through. It should, however, be pointed out that hostile submarines can generally pass through the most cleverly defended channel, *provided there is a sufficient depth of water to allow them room to dive under the mine-fields.* This should not be less than 100 feet. For a submarine to pass through a *shallow* channel defended by mines is an extremely difficult and dangerous

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operation. The average depth of the Dardanelles, through which British submarines passed continuously and with little loss during the recent operations, is approximately 150 to 200 feet; but there are strong and dangerous currents which are always a drawback to submarine operations.

When the line of advance of a hostile fleet runs parallel, and in fairly close proximity to a friendly coast, there is the ideal opportunity for a succession of submarine attacks, not always directed from the nearest base, but ingeniously planned for simultaneous attacks from the directions least likely to be anticipated. The point of convergence of trade routes; the entrance or exit of ocean canals, such as the Suez and Panama; hostile naval repair bases; passages between dangerous shoals or rocks—all these positions are strategic points for submarines, and illustrate the influence of geographical features on the conduct of submarine warfare. Climatic conditions also have their bearing. "Low visibility and calm sea are the most unfavourable conditions under which submarines can operate," says Commodore Roger B. Keyes, C.B., who commanded the British submarines operating in the Heligoland Bight.

The Baltic in one way favours the employment of submarines because for several months in the year the daylight is of long duration, and surface torpedo-boats would be useless, and for another four months out of the twelve it is naturally defended by ice. The disadvantage of perpetual daylight is that submarines have not the friendly darkness to cover them when they rise to recharge their batteries. Where the water is thick or brackish there is less likelihood of submarines being spotted by seaplanes; and where the

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surface is frequently broken by large fish the difficulty of detecting the periscope of a submarine is greatly increased. Many other geographical and climatic conditions could be cited, both favourable and unfavourable to the employment of submarines, but the foregoing remarks sufficiently indicate them. Having set the train of thought, nothing further need be said.

Admiral Sir R. H. S. Bacon, D.S.O., one of the pioneers of the British flotillas, has said that it is the human element which must always be the supreme factor in submarine work. This brings us to the question of *national characteristics* in relation to submarine warfare. The natural dislike, inherent in Englishmen, of change, stealthy warfare, subterfuge, and science, as opposed to personal bravery, has combined with the pride in the great navy created, and the vital necessity of maintaining the command of the sea in its fullest sense, to retard the proper recognition of the submarine and the great part this type of warship is destined to play in future naval warfare. We can command the surface, but can we command the under-seas? is the uppermost thought in the national brain when the progress of the submarine is brought vividly to mind; and although the answer is a vague "yes," it does not seem so certain as it would be if surface ships alone had been in question. The result is in many cases a mental resolve to belittle *the cause of the doubt*, and to "wait and see." Had the question of the command of the seas and under-seas been pursued further, it would have become apparent that a nation does not command the sea solely because of the number of warships actually upon it; geographical position, bases, national charac-

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teristics and aspirations, shipbuilding facilities, financial and mineral resources, and many other factors play a part; but this question is more fully dealt with towards the end of this book, and it is sufficient to say here that to belittle any new weapon of war because of the reasons given is much like imitating the ostrich with its head in the sand.

The most admirable strategic plan may be spoiled by lack of skill, initiative, patience, or prudence, in execution, and all these qualities, including courage, to a degree verging on genius, are required of submarine commanders. The policy of the British Navy has always been an offensive one, and the submarine is essentially an offensive weapon. It can be used to attain the most advanced position, to pass under a hostile fleet and raid the lines of communication, and to act as an advance guard or scout far ahead of a main surface fleet. The defence usually occupies a position and then waits to be attacked before striking back. This is certainly not the rôle of the submarine, which should always endeavour to use its strategic and tactical ability of remaining invisible to strike the first blow at the most advanced point. Even should the actual policy of a navy be a defensive one, then that policy can best be carried out by offensive strategy, and the use of submarines not solely as coast defenders tied to a base or narrow strip of sea, but as an attacking fleet searching for the enemy, regardless of that enemy's strength.

An example of this is best afforded by quoting from the dispatch of the Commodore commanding the British submarines in the North Sea, covering the activities of these vessels from the opening of hostilities to October 1914.

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"Three hours after the outbreak of war, submarines E6 and E8 proceeded unaccompanied to carry out a reconnaissance in the Heligoland Bight. These two vessels returned with useful information, and had the privilege of being the pioneers on a service which is attended by some risk.

"During the transportation of the Expeditionary Force the *Lurcher* and *Firedrake* and all the submarines of the eighth submarine flotilla occupied positions from which they could have attacked the high-sea fleet, had it emerged to dispute the passage of our transports. This patrol was maintained day and night without relief, until the personnel of our army had been transported and all chance of effective interference had disappeared.

"These submarines have since been incessantly employed on the enemy's coast in the Heligoland Bight and elsewhere, and have obtained much valuable information regarding the composition and movement of his patrols. They have occupied his waters and reconnoitred his anchorages, and, while so engaged, have been subjected to skilful and well-executed anti-submarine tactics; hunted for hours at a time by torpedo craft and attacked by gun-fire and torpedoes.

"At midnight on 26th August I embarked in the *Lurcher*, and, in company with *Firedrake* and submarines D2, D8, E4, E5, E6, E7, E8, and E9 of the eighth submarine flotilla, proceeded to take part in the operations in the Heligoland Bight arranged for 28th August. The destroyers scouted for the submarines until nightfall on the 27th, when the latter proceeded independently to take up various positions from which they could co-operate with the destroyer flotillas on the following morning.

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"At daylight on 28th August the *Lurcher* and *Firedrake* searched the area, through which the battle-cruisers were to advance, for hostile submarines, and then proceeded towards Heligoland in the wake of submarines E6, E7, and E8, which were exposing themselves with the object of inducing the enemy to chase them to the westward.

"On approaching Heligoland, the visibility, which had been very good to seaward, reduced to 5000 to 6000 yards, and this added considerably to the anxieties and responsibilities of the commanding officers of submarines, who handled their vessels with coolness and judgment in an area which was necessarily occupied by friends as well as foes.

"Low visibility and calm sea are the most unfavourable conditions under which submarines can operate, and no opportunity occurred of closing with the enemy's cruisers to within torpedo range.

"Submarine E4 witnessed the sinking of the German torpedo-boat destroyer V187 through his periscope, and, observing a cruiser of the Stettin class close and open fire on the British destroyers, which had lowered their boats to pick up the survivors, he proceeded to attack the cruiser, but she altered course before he could get within range. After covering the retirement of our destroyers, which had had to abandon their boats, he returned to the latter, and embarked a lieutenant and nine men of *Defender*, who had been left behind. The boats also contained two officers and eight men of V187, who were unwounded, and eighteen men who were badly wounded. As he could not embark the latter, Lieutenant-Commander Leir left one of the officers and six unwounded men to navigate the British boats

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to Heligoland. Before leaving, he saw that they were provided with water, biscuit, and a compass. One German officer and two men were made prisoners of war.

"Lieutenant-Commander Leir's action in remaining on the surface in the vicinity of the enemy and in a visibility which would have placed his vessel within easy gun range of an enemy appearing out of the mist, was altogether admirable.

"This enterprising and gallant officer took part in the reconnaissance which supplied the information on which these operations were based, and I beg to submit his name, and that of Lieutenant-Commander Talbot, the commanding officer of E6, who exercised patience, judgment, and skill in a dangerous position, for the favourable consideration of their lordships.

"On 13th September, E9 (Lieutenant-Commander Max K. Horton) torpedoed and sank the German light cruiser *Hela* six miles south of Heligoland.

"A number of destroyers were evidently called to the scene after E9 had delivered her attack, and these hunted her for several hours.

"On 14th September, in accordance with his orders, Lieutenant-Commander Horton examined the outer anchorage of Heligoland, a service attended by considerable risk.

"On 25th September, submarine E6 (Lieutenant-Commander C. P. Talbot), while diving, fouled the moorings of a mine laid by the enemy. On rising to the surface she weighed the mine and sinker; the former was securely fixed between the hydroplane and its guard; fortunately, however, the horns of the mine were pointed outboard. The weight of the

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sinker made it a difficult and dangerous matter to lift the mine clear without exploding it. After half an hour's patient work this was effected by Lieutenant Frederick A. P. Williams-Freeman and Able Seaman Ernest Randall Cremer, Official Number 214,235, and the released mine descended to its original depths.

"On 6th October, E9 (Lieutenant-Commander Max K. Horton), when patrolling off the Ems, torpedoed and sank the enemy's destroyer, S126.

"The enemy's torpedo craft pursue tactics which, in connection with their shallow draft, make them exceedingly difficult to attack with torpedo, and Lieutenant-Commander Horton's success was the result of much patient and skilful zeal. He is a most enterprising submarine officer, and I beg to submit his name for favourable consideration.

"Lieutenant Charles M. S. Chapman, the second in command of E9, is also deserving of credit.

"Against an enemy whose capital vessels have never, and light cruisers have seldom, emerged from their fortified harbours, opportunities of delivering submarine attacks have necessarily been few, and on one occasion only, prior to the 13th September, has one of our submarines been within torpedo range of a cruiser during daylight hours.

"During the exceptionally heavy westerly gales which prevailed between the 14th and 21st September the position of the submarines on a lee shore, within a few miles of the enemy's coast, was an unpleasant one.

"The short steep seas which accompany westerly gales in the Heligoland Bight made it difficult to keep the conning-tower hatches open. There was no rest to be obtained, and even when cruising at a depth of 60 feet the submarines were rolling con-

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siderably, and pumping—*i.e.* vertically moving about 20 feet.

"I submit that it was creditable to the commanding officers that they should have maintained their stations under such conditions."

In bringing to a conclusion this chapter on the influence of the submarine on the elements of naval strategy, it should be borne in mind that the ability of the submarine to manœuvre below the surface confers upon her the great *strategic* as well as tactical faculty of being able to move from a base to almost any point in the theatre of war unknown to and unhindered by any dispositions of the enemy, thus allowing a choice of positions impossible to any other type of warship. Again Napoleon's dictum, "War is a business of positions."

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II

SUBMARINES AND THE CONVERSION OF "INFERIOR INTO SUPERIOR FORCE"

WE have so far analysed the influence of the submarine on the principal interior and exterior elements of naval strategy, applied in a variety of ways. There remains now to consider the even greater influence of this type of warship on certain specified operations of war, first in importance among which comes the great aid it affords in the conversion of inferior into superior force.

The "policy of attrition," of which so much was heard during the first phase of the Great War, in 1914–16, is nothing more than one method of applying that older and broader aphorism: "The art of war consists of converting inferiority into superiority at a given point." The German high-sea fleet, being greatly inferior in numbers and gun power to the concentrated British Grand Fleet, sought, by remaining in safety behind its land fortifications and sending forth its powerful submarine flotilla, so to weaken British naval power by the torpedoing of units, while its own numbers were being rapidly augmented from the shipyards, that at a moment before the conclusion of the war the fleet of England would have been so thinned out by submarine attacks as to be only equal or but little superior to the

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strengthened and intact German fleet. The utter failure of this strategy was due, first, to the prudence of the British Naval Command, which foresaw the danger of exposing the Grand Fleet to submarine attacks; and, acting on the maxim that battleships should only be risked for a decisive object, withdrew the main fleet to a strategic point, where, although comparatively safe from the submarine menace, it could intercept any large hostile fleet, worthy of its steel, coming out of the Heligoland Bight or round the Danish coast, the closer lines of the blockade being maintained by British submarines supported when necessary by destroyers and cruisers. Wireless telegraphy assured the Grand Fleet of knowing the shortest line to the point of interception should the German fleet put to sea in force. Secondly, the failure of this German plan was due to the great superiority of the British fleet, which made a sufficient reduction in its numbers, compared with the rapidity fo warship construction in the British Isles, an impossible task from the outset, with so small a submarine flotilla as was possessed by the German Navy. The employment of explosive mines on an unprecedented scale was intended to supplement the work of the submarines, but it lacked the element of success, viz. *a necessity* or irresistible inducement for the surface fleet to pass over the mine-fields. The bombardment of Scarborough and other places on the English east coast was, however, a callously conceived attempt to induce a powerful British fleet to expose itself to submarine attack, on the assumption that popular clamour would compel the Admiralty to weaken its main fleet by detaching a large squadron for coast defence, and that these ships,

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in order to effectively carry out their duties, would be used to augment the patrols in the North Sea and would thus be continually exposed to destruction by submarines and mines. When the German naval staff realised the futility of these very apparent devices they turned their attention from the naval to the *military* possibilities of submarine warfare, and conceived the brilliant idea that with the 150 submarines they possessed, amplified with a touch of "frightfulness" and the "bluff" of a submarine blockade of the English coast, they could prevent the sailings of the 1200 vessels which on an average enter and leave the ports of the United Kingdom weekly, and by so doing not only cause starvation and panic in England, but also cut off the supplies of food and ammunition from the United States, necessary for the Allied armies in the field.

All these were ambitious schemes which showed lamentable lack of naval judgment. A policy of attrition based on the skilful use of powerful submarines can be most advantageously employed against a hostile surface fleet compelled or induced to operate in a theatre of war distant from its own base. Had Togo possessed a flotilla of large submarines he could have greatly weakened the Russian Baltic fleet on its arrival in Far Eastern waters before engaging it in open battle. Similarly, had the Port Arthur division been strong in submarines, it could doubtless have used them to weaken the Japanese forces before attempting a junction with the Baltic fleet. In this way the coast-line of the United States favours a submarine offensive as it is a long distance from any hostile naval base; and the outlying British Dominions, such as Australia, New Zealand, and

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Canada, could very advantageously employ submarines to weaken any approaching hostile surface fleet.

It is not only by attrition that submarines can aid in the conversion of inferior into superior force at a given point, which does not necessarily mean that the total naval forces of one must be superior to the total naval forces of the other, but that it should be the great aim of strategy to make them so *at a given point*, or at the moment of a decisive engagement. Thus, with two opposing fleets at sea, one of which is inferior to the other, the strategic aim of the commander of the inferior fleet would be to induce his opponent to divide his fleet, then to occupy the *central position*, and engage each half of the divided enemy fleet separately. If this manœuvre was successful he would have converted his own inferiority into a superiority over the half which he intended to engage first. To effect this necessary consummation before being brought to action by the superior fleet requires great strategic skill and ingenuity, and the history of naval war affords many examples of it, both successful and unsuccessful. All that concerns this work is, however, to show in what manner submarines can aid in the conversion of inferior into superior force, without resorting to the necessarily long and often ineffective policy of attrition.

A concentrated surface fleet of large vessels when cruising in search of an enemy is always more or less conscious of its vulnerability to submarine attack, the degree of apprehension being measured by the proximity of the fleet to hostile submarine bases, the number of fast vessels available for beating off such an attack, and whether or not the geographical and

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climatic conditions favour the employment of submarines. An extract from the dispatch of Admiral Sir David Beatty, K.C.B., describing the dash by British cruisers into the Heligoland Bight on 27th August 1914, gives an excellent example of the influence of the submarine on the commander of a surface fleet.

"From the foregoing the situation appeared to me critical. The flotillas had advanced only 10 miles since 8 a.m., and were only about 25 miles from two enemy bases on their flank and rear respectively. Commodore Goodenough had detached two of his light cruisers to assist some destroyers earlier in the day, and these had not yet rejoined (they rejoined at 2.30 p.m.). As the reports indicated the presence of many enemy ships—one a large cruiser—I considered that his force might not be strong enough to deal with the situation sufficiently rapidly, so at 11.30 a.m. the battle-cruisers turned to E.S.E., and worked up to full speed. It was evident that to be of any value the support must be overwhelming, and carried out at the highest speed possible.

"*I had not lost sight of the risk of submarines*, and possible sortie in force from the enemy's base, especially in view of the mist to the south-east.

"*Our high speed, however, made submarine attack difficult, and the smoothness of the sea made their detection comparatively easy.*"[1]

From this it will be seen that, although undeterred by the possible presence of submarines, Sir David Beatty had his own vulnerability to their attack in mind throughout the action, but considering that the climatic conditions—smooth sea and rather low

[1] Italics not in original.

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visibility—and the high speed of his squadron—26 to 28 knots—made a successful submarine attack extremely difficult, he felt justified in exposing his great battle-cruisers in order to gain quick and decisive results over the enemy's surface ships. That these results were decisive is proved by two paragraphs of the same dispatch: "At 12.15 p.m., *Fearless* and first flotilla were sighted retiring west. At the same time the light cruiser squadron was observed to be engaging an enemy ship ahead. They appeared to have her beat.

"I then steered N.E. to sounds of firing ahead, and at 12.30 p.m. sighted *Arethusa* and third flotilla retiring to the westward engaging a cruiser of the Kolberg class on our port bow. I steered to cut her off from Heligoland, and at 12.37 p.m. opened fire. At 12.42 the enemy turned to N.E., and we chased her at 27 knots.

"At 12.56 p.m., sighted and engaged a two-funnelled cruiser ahead. *Lion* fired two salvoes at her, which took effect, and she disappeared into the mist, burning furiously and in a sinking condition. . . ."

At this point in the action the submarine arms again come into play. "Our destroyers had reported the presence of floating mines to the eastward, *and I considered it inadvisable to pursue her.* It was *also* essential that the squadrons should remain concentrated, and I accordingly ordered a withdrawal. The battle-cruisers turned north and circled to port to complete the destruction of the first vessel engaged. She was sighted again at 1.25 p.m., steaming S.E., with colours still flying. *Lion* opened fire with two turrets, and at 1.35 p.m., after receiving two salvoes, she sank."

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About ten minutes later, hostile submarines came into action. "At 1.40 p.m. the battle-cruisers turned to the northward, and *Queen Mary* was *again* attacked by a submarine. The attack was avoided by the use of the helm. *Lowestoft* was also unsuccessfully attacked. The battle-cruisers covered the retirement until nightfall."

In this instance the smooth sea, the speed of the squadron, and adroit manœuvring, prevented the submarine attacks from being successful; but notwithstanding that "the smoothness of the sea made their detection comparatively easy," it is instructive to note that although three attacks were made at times when the ships attacked were not engaging a surface enemy, and that there was a number of destroyers in the vicinity, no mention is made in the dispatch of any of the hostile submarines being sunk by gun-fire or by ramming. It was the duty of the battle-cruisers to avoid submarine attacks and not to court disaster by attempting to engage the enemy's under-water craft. This they did by manœuvring *or giving them as wide a berth as possible.* The light cruisers and destroyers were apparently too closely engaged with hostile surface craft to have any opportunity of giving attention to the enemy's submarines. Under these circumstances, had the German submarines been in great force they could doubtless have inflicted serious damage on the British squadrons. This is a point in favour of their employment in conjunction with surface fleets. During a hard-fought action the surface ships of either side would have little opportunity of avoiding concentrated submarine attacks, their attention being too fully occupied with the surface fighting.

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The point to be observed is, however, that it was the duty of the battle-cruisers to avoid the submarine attacks at all costs. This they did by the most reliable method known—rapid manœuvring. Had one of these big vessels been disabled by a torpedo she must have been left to her fate so far as the other large surface ships were concerned. After the sinking of the cruisers *Aboukir*, *Cressy*, and *Hogue*, which was partly due to one vessel stopping to help the other, the British Admiralty issued the following statement:

"Modern naval war is presenting us with so many new and strange situations that an error of judgment of this character is pardonable. But it has been necessary to point out for the future guidance of His Majesty's ships, that the conditions which prevail when one vessel of a squadron is injured in a mine-field or is exposed to submarine attack, are analogous to those which occur in an action, and that the rule of leaving disabled ships to their own resources is applicable, so far at any rate as large vessels are concerned. No act of humanity, whether to friend or foe, should lead to a neglect of the proper precautions and dispositions of war, and no measures can be taken to save life which prejudice the military situation. Small craft of all kinds should, however, be directed by wireless to close on the damaged ship with all speed."

This order makes it apparent that when big ships are attacked by submarines they must not rely on gun-fire—as did the *Cressy* and *Hogue*—as a means of defence, but must utilise their speed and manœuvring ability to place themselves out of range of their under-water opponents.

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Nelson's advice on concentration of attack when he dispatched two ships on an expedition should always be borne in mind by submarine commanders: "If you meet two enemies, do not each attack one. Combine both on one of the enemy; you will make sure of that one, and you may also get the other afterwards; but, whether the second escape or not, your country will have won a victory and gained a ship."

This brings us back to the original problem; the conversion of inferior into superior force at a given point. It has been necessary, before showing in what manner submarines can aid a surface fleet endeavouring to carry this plan into effect, to demonstrate conclusively—(1) the influence of the presence of submarines on the commander of a surface fleet exposed to their attack, even when steaming into action; this can be judged from Admiral Beatty's dispatch and the remarks of other naval commanders given in Part I. of this work; (2) the recognition by naval authorities that gun-fire is not a reliable defence against submarines, and the advice to commanders of large surface warships to use their speed and manœuvring powers *to get out of the way* when attacked by under-water craft—this is evidently the meaning of the Admiralty order to the larger units of the British fleet; and (3) that a submarine flotilla can by *combining* its attack on a *few* of the big vessels of a hostile fleet cause the remaining large vessels to immediately steam off out of range, and at the same time collect to the scene all the smaller hostile craft. This is in accordance with that paragraph of the British Admiralty statement which says: "Small craft of all kinds should, however, be

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directed by wireless to close on the damaged ship with all speed."

This is, in itself, a general order sanctioning—unavoidably, it is true—the displacement of force, of which advantage might be taken by an inferior surface fleet coming at full speed to the aid of its submarines and taking up the central position. From this point it could deliver a crushing blow at the enemy's small craft collected round the one or more torpedoed big ships, whilst the submarines could manœuvre so as to prevent the return to the scene and intervention of the main body of the enemy in time to be of avail, or, failing this, could in all probability inflict further damage on the enemy's big ships before they could come into action with the hitherto inferior fleet.

By these or other similar means, according to circumstances, an inferior surface fleet *which is strong in submarines* can convert its inferiority into superiority at the moment of decisive action. Possibly the loss in submarines might be rather heavy, but this would be more than justified if the final result was a victory for the inferior fleet.

The tactics at Trafalgar provide an analogy. Nelson concentrated the largest portion of his fleet—a superior force—on the rear of the enemy's line, whilst against the van he dispatched a smaller force. The concentrated attack of the superior force on the enemy's rear he placed in the hands of his second in command, while he, himself, led the attack of the inferior force on the van. By this manœuvre, Nelson prevented the weakly engaged van from coming to the aid of the hard-pressed rear. The result was a crushing defeat of the rear vessels and the escape of

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the vanguard. The victory was, however, decisive, because the enemy's van which escaped was, even if concentrated and repaired, no match for Nelson's victorious combined fleet.

The fighting order of a fleet has, from time immemorial, been a line, which is called a column, because the ships advance one behind the other. But if the arrangement of the guns is considered it will be seen that the ships are really deployed so as to present a line to the enemy. An attack in overwhelming force is usually made on one flank of that line (*i.e.* van or rear of column), as at Trafalgar, while the opposite flank is just held in check by an inferior force. These tactics give superiority of force *at the decisive point*, and are aided by the fact that either one or both flanks can more easily help the centre of a line than they can aid each other, owing to the distance which separates them being only half.

With a large fleet many miles of sea separate the van from the rear, and by the concentrated employment of a large flotilla of submarines it should not be difficult to either divide this line, or lines, into one or more separate parts or else to throw it into confusion, immediate advantage of which can be taken by the surface fleet supporting the submarines. Doubt may be expressed as to the possibility of the submarines being able to get within range of the big hostile surface fleet when in battle formation, owing (1) to their slower speed, and (2) to the activities of destroyers. The first is a legitimate difficulty which can only be overcome by adroit manœuvring on the part of the surface fleet supporting the submarines, which must refuse battle until the right position is obtained. This may possibly be done by considering

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the submarine flotilla as the central position, and manœuvring round it. To meet the second difficulty, decoy submarines can be detached from the flotilla to occupy the attention of the hostile destroyers, and so clear the way for the main flotilla. This would be similar to the manœuvre successfully accomplished by German submarines off the Belgian coast. An attack was made by surface torpedo-boats and submarines on the British monitors and other vessels bombarding the Belgian coast. These were engaged and chased off, after suffering loss, by the light armoured cruiser *Undaunted* and her attached flotilla of destroyers. In the meantime, other submarines had slipped past the cordon into Zeebrugge and Ostend.[1]

In this or other way suitable to the occasion little difficulty should be experienced in getting at least half the total number of under-water craft available to within torpedo range of the enemy's main fleet. Now as regards the confusion likely to be caused in the enemy's columns by a submarine attack. It has already been shown that naval authorities are agreed that a big surface ship should not rely on gun-fire to beat off a submarine attack, but should seek to avoid the encounter by rapid manœuvring, as was three times successfully employed during the action of the British battle-cruisers in the Heligoland Bight. If two or three vessels in a column, or columns, begin rapid manœuvring independent of the vessels in their van and rear, the whole line is immediately thrown

[1] That the German submarines operating from the Belgian bases achieved but little success was due to the shallow draft of the monitors, and their special construction, which rendered them almost immune to submarine attack, but of very slow speed. (See Chapter on the Development of the Counter-Attack.)

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into disorder, and in the face of a number of well-handled, active submarines it would be some considerable time before the order of battle could be renewed. In the meantime the opposing surface fleet would take advantage of the confusion in the ranks of the enemy.[1]

These evolutions would, of course, fall under the heading, not of strategy, but of tactics, as all the fleets and flotillas engaged would be at the point of contact. It has already been proved that submarines can operate with comparative safety in a battle-zone, and can act in conjunction with surface fleets. In support of this there was the co-operation between German cruisers, destroyers, and submarines in the action off Heligoland; the operations of the British submarine E4, which lay unobserved in the midst of an action between surface ships, and is reported in the Commodore's dispatch as having "witnessed the sinking of the German torpedo-boat destroyer V187, through the periscope (up to about 3000 yards). Observing a cruiser of the Stettin class close and open fire on the British destroyers, which had lowered their boats to pick up the survivors, he proceeded to attack the cruiser, but she altered course before he could get within range." Afterwards this submarine covered the retirement of the British destroyers. If any further proof is required of the ability of submarines to operate under the most difficult and trying conditions of warfare, we have it in a dispatch describing the work of British submarines during the first few months of the European War. "These sub-

[1] Additional evidence of the influence of the submarine on the operations of a surface fleet can be obtained by a careful study of *The Grand Fleet*, by Admiral Viscount Jellicoe of Scapa.

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marines have since been incessantly employed on the enemy's coast in the Heligoland Bight and elsewhere, and have obtained much valuable information regarding the composition and movements of his patrols. They have occupied his waters and reconnoitred his anchorages, and, while so engaged, have been subjected to skilful and well-executed anti-submarine tactics; *hunted for hours at a time by torpedo craft, and attacked by gun-fire and torpedoes.*"

In modern war, in which science and engineering play an ever increasing part, if the forces on both sides were always equal at the moment of contact there would be no material result, or advantage; but if one side is inferior at the critical moment, then it will almost certainly be defeated and probably destroyed. "It is in converting inequality or inferiority into superiority at a given point," says Admiral Mahan, "that the science, or rather the art, of war exists."

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III

THE INFLUENCE OF THE SUBMARINE ON SPECIFIED OPERATIONS OF NAVAL WAR

THE submarine is an ideal sea-scout, because it can evade the enemy's outer guard and ascertain from close quarters the real inner strength or weakness; can wait and watch quite unknown to the enemy; and at the same time it can, if occasion offers, deliver an attack on the largest warship with reasonable chances of success. It frequently happens that a scout's greatest difficulty is not in obtaining the information required, but in afterwards getting away with it. As will at once be seen, a submarine, in this respect, possesses great advantages over a surface vessel. If it succeeds in getting to an observing point unknown to the enemy, there is little danger of it being unable to extricate itself. Should it be discovered, it can make itself immune to gun-fire by submergence, and can generally baffle pursuit until darkness closes over, when it is almost compelled to come to the surface. At this critical time the submarine obtains the advantage of her higher surface speed; and should it be "cornered" by numerous destroyers with the aid of searchlights, there is usually sufficient time to change to the awash condition and then to dive deep beneath the keels of the pursuers. Although blind—owing to the uselessness of the peri-

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scope at night—a submarine diving under the surface to avoid destruction can travel with safety for a considerable distance, providing there is a sufficient depth of water to allow her to pass under the keels of the surface warships without risk of striking the sea-bed. The only danger would come from depth-charges dropped within one hundred feet of her. A surface torpedo-boat or destroyer might succeed in getting close to a hostile fleet during the night, but it would be compelled to retreat before the daylight—necessary for its own observations—disclosed its position to the enemy. Seaplanes are of great use in this important respect, but the advantages they gain from high speed and almost certain immunity from interruption are counteracted by the comparatively short space of time they can remain in the air, the difficulty of using them in rough weather, and the fact that they can be seen by the hostile fleet and its scouts, who are thus placed on the alert.

The use of wireless telegraphy has added greatly to the value and reliability of submarine reconnaissance. For by its aid the speed disability of the submarine when returning with intelligence gathered has been overcome. They can now "wireless" to any point within about 100 miles, and should the distance between the main fleet and the scouting submarines exceed the limits of direct communication, they can either "drop" a vessel for each 80 miles advance, or else send the messages to a supporting destroyer flotilla for transmission to a base, fleet, or squadron.

In the domain of intelligence the submarine has played a conspicuously successful part in recent naval operations. Three hours after the declaration of war between England and Germany, British submarines were reconnoitring in the Bight. On 14th September

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a submarine examined the outer anchorage of Heligoland—"a service attended by considerable risk." Russian submarines have been close up to the outer defences of Kiel Bay. British submarines have penetrated the Dardanelles defences and operated in the Sea of Marmora. German submarines have run the gauntlet of hundreds of patrols along the coasts of England, Scotland, and Ireland; and in many cases have returned to their base with the information gathered. Mr. Churchill, then First Lord of the Admiralty, has stated that the successful cruiser operations on 28th August 1914 were due in the first instance to the information brought to the Admiralty by the submarine officers, who had shown "extraordinary daring and enterprise in penetrating the enemy's waters."

These achievements must place the submarine in the forefront for sea reconnaissance.

On the application of the principles of a blockade the submarine has had a truly revolutionising influence. It is no longer possible for a surface fleet of sufficient power to cope with a sortie in force to maintain a day and night vigil close to a hostile port or coast-line defended by submarines. A fleet operating in this way must keep at a much greater distance than has ever before been considered either necessary or advisable,—the actual blockade being maintained by an inlying patrol of submarines, supported by an outer cordon of destroyers with cruisers within call. These must be in constant wireless communication with the main blockading fleet, which acts as a *strategic reserve*, only to be called to the scene in the event of a sortie in considerable force, or

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a serious attempt to break down the blockade. The main fleet must be so placed in the rear of the actual blockading line as to be itself guarded from submarine attack, and yet in such a strategic position as to be instantly ready and able to intercept any large hostile fleet attempting to enter or leave the blockaded port or coast. If the geographical features do not lend themselves to such a disposition, recourse can be had to extensive mine-fields for closing certain routes which cannot be covered by the main blockading fleet. When it is desired to completely seal up a hostile port, mines in conjunction with a numerous submarine flotilla and a few destroyers, cruisers, and armed seaplanes can usually be relied upon. The points to be noted are: (1) that no defence at present known can in anyway be relied upon to prevent hostile submarines running the blockade with comparative ease and safety; and (2) that a close blockade of a submarine-defended base by surface warships of large size and gun power is no longer possible, unless of the new monitor type.

The truth of the first of these statements has been amply demonstrated by recent events,—more especially the repeated penetration of the Dardanelles by British submarines,—and makes it necessary for the main fleet, even when many leagues distant from the blockaded port or coast, to be carefully guarded from hostile submarine attack, which will in most cases be repeatedly attempted by an enterprising enemy. Care must also be taken against assuming that *any* of the enemy's ports, both large and small, are without submarines. They may be at the time when the blockade is first instituted, but the facility with which this type of craft can get in or out of a blockaded

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port, combined with the chances offered for successful submarine sorties, will soon attract them to the blockaded coast. In recent warfare, examples of this were afforded by Germany in its efforts to make Zeebrugge, on the blockaded Belgian coast, a base for submarine activities; and by Turkey and Bulgaria. In both these cases German naval authorities saw the menace to the bombarding and blockading Allied fleets which would be invoked by the use of submarines along the closed coasts. Many of these vessels were sent from Germany and reached successfully the blockaded coasts.

Important movements of a main blockading fleet, such as the temporary weakening of it, although situated many miles distant from the invested base, will in all probability be immediately reported to the hostile fleet or squadron in the blockaded port by its scouting submarines. There can be little doubt that the position and movements of the British Grand Fleet and the main North Sea patrols were known to the German naval authorities through the scouting abilities of their submarines, and that this made possible the raids on Scarborough, the Hartlepools, and elsewhere by German cruisers without interception.

Returning to the position which a main blockading fleet must occupy when watching a hostile coast, a practical illustration was the stationing of the Japanese battleships at the Elliot Islands, 60 miles from Port Arthur, which they were blockading. Strategically, this position, which was carefully defended against torpedo attack, rendered the main Japanese fleet able to intercept any fleet attempting to enter or leave Port Arthur, and at the same time gave it a favour-

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able position for intercepting the Russian Baltic Fleet, which was approaching Far Eastern waters. In the same way the British Grand Fleet in the great European War first occupied a strategic position in Scapa Flow distant about 460 miles from Heligoland, which it was watching in conjunction with the passage round the Danish coast from Kiel to the North Sea. In this case—unlike the Japanese before Port Arthur—submarines were the source of danger, and elaborate precautions were taken to prevent a successful attack.[1] The strategic position was such as to enable the Grand Fleet to intercept the High Sea Fleet on leaving German waters, should it turn either to the north-west or south-west.

We now come to the question of *a submarine blockade.* This new factor in naval warfare has loomed both large and small in recent operations. Large, because its future possibilities under certain defined conditions have been clearly demonstrated; and small, because its practical results when misapplied have been insignificant. An effective submarine blockade of the coasts of Great Britain could never have been considered by the German naval staff as within the realm of possibility *as an effective operation in itself*—hence the declaration of a "War Zone" and not a blockade.

The essential factors were as follows: (1) the length of coast-line to be closed was just under 1000 miles, if only the Atlantic side—food and ammunition routes—was included; (2) the number of ports available for ocean traffic along this 1000 miles of coast-line numbered about forty, which may be divided into six groups, all being many miles distant

[1] See *The Grand Fleet*, by Admiral Viscount Jellicoe.

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from each other—*A.* Northern Scottish Loch Group, *B.* Clyde Group, *C.* Mersey Group, *D.* Welsh Group, *E.* Bristol Channel Group, and *F.* English Channel Group; the wide ocean approaches to all of these made submarine attack difficult; (3) the average annual volume of shipping entering and leaving the ports of the United Kingdom amounted to about 133 million tons, out of which over 1000 vessels a week were engaged on the Atlantic routes; and (4) the number of armed ships available for the defence of this "blockaded" coast, and the protection of the vital trade routes *at their converging points*, could not have been estimated by the German naval staff at less than 1000, exclusive of the battle fleets.

These, then, were the primary factors, or what may be termed the strength of the defence, exclusive of any warlike operations against the blockading submarines by the supreme navy and its hundreds of armed auxiliaries. To successfully carry out the theory of blockading the 1000 miles of coast-line, exposed to heavy ocean seas, with its forty ports in six separate groups, and its weekly sailings of 1500 vessels guarded by 1000 armed ships, exclusive of an immense navy, the Germans possessed—(1) a fleet of about 150–200 large and powerful submarines with a surface radius of action of about 8000 miles, which allowed them to accomplish the 1800-mile voyage out and home to Heligoland and spend about a fortnight at a time on the Atlantic coast of Great Britain; (2) the facilities for the rapid construction of these vessels, which would allow them to build and equip new submarines to take the place of those lost, *if the losses were not too rapid*, and also to increase their flotilla; and (3) the moral effect produced by

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the sinking of several large vessels with the loss of many lives, which would (so it was thought) deter merchant shipowners, sailors, and passengers from taking the risks involved by running the blockade.

In addition to the patent impossibility of performing such a gigantic task with so few vessels, there were four scientific and strategic factors which could not be overcome: these were—(1) the elementary fact that submarines cannot operate submerged during the night, owing to the fading vision of the periscope as daylight gives place to darkness; had it been necessary, this alone would have allowed merchant vessels to dash through the danger zone during the hours of darkness, which, when carried out with the aid of a large number of surface patrols, would have enormously reduced the risk; (2) the necessity for dividing the comparatively few submarines possessed by Germany for the accomplishment of this gigantic task into two or more flotillas, only one of which could be employed at a time for blockading purposes, the others being either replenishing supplies and resting at a base, or else on their way to or from it—this reduced the number which could be actively employed simultaneously by at least 50 per cent.; and (3) the certainty that this destruction of life and commerce would not be allowed to proceed quite unchallenged; that the heavy seas which sweep the shores of Britain during many months in the year would take their toll; and finally, that in such dangerous work disasters must occur. If due consideration was given to these points, as undoubtedly it was by the German staff, the losses could not have been placed at less than two vessels per voyage, or 24 vessels per annum, and no ex-

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aggeration of resources could have led to the belief that even with all their yards clear of surface ships a much greater rate of construction than two vessels a month was possible, considering that previous to the outbreak of war each big submarine took at least nine months to construct and equip; and (4) the fact that not more than 14 torpedoes could be carried by each vessel, which would give the full active submarine fleet of 75 vessels 1000 torpedoes a fortnight with which to maintain the blockade against 1000 armed surface ships and weekly sailings by over 1500 merchantmen,—it being previously known to all naval authorities that with the very greatest skill and under the most favourable combination of circumstances not more than one in every three torpedoes discharged from a submarine hit the object aimed at. It should be remembered that at least one-third of the armed patrols would also be in harbour, leaving an active fleet of 667.

That even a partially effective submarine blockade of the coasts of Great Britain was known to be practically impossible by the German naval staff with anything like the small number of vessels available, and, with the British fleet still in undisputed control of the surface, must be taken for granted. The loudly proclaimed "War Zone" was a cleverly conceived double-edged sword—a *ruse de guerre*. German submarines carried on guerilla attacks on British merchant ships for many months after the declaration of war; then perceiving that, beyond the sinking of a few with but little loss of life, the real object of these attacks—the intimidation of neutral and British shipping—was not being attained, a new policy was proclaimed. The waters adjacent to the

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British Isles were declared to be a "War Zone" (18th Feb. 1915), care being exercised not to officially describe the operations which were to follow as a "submarine blockade," for this would, as the *Tages Zeitung* pointed out, have entailed the observance of certain international laws on naval blockade. This new policy was based on "bluff," for nothing but the comparatively small flotilla of submarines which had been actively employed in the same way since the outbreak of war would be used, with the possible addition of a few newly completed units. The declaration of the war zone and the ruthless employment of both submarines and mines, to begin on the fixed day, 18th February, was loudly proclaimed in neutral countries. German Embassies issued to the Press of the countries to which they were accredited warnings to neutral shipping, of which the following is a specimen, being the concluding paragraph of a note handed to the State Department at Washington by Count Bernstorff: "In these circumstances the safety of neutral shipping in the war zone around the British Isles is seriously threatened. There is also an increased danger resulting from mines, as these will be laid in the war zone to a great extent. Accordingly, neutral ships are most urgently warned against entering that area, while the course around Scotland will be safe. Germany is compelled to resort to this kind of warfare by the murderous ways of British naval warfare, which aims at the destruction of legitimate neutral trade, and at the starvation of the German people. Germany will be obliged to adhere to these announced principles till England submits to the recognised rules of warfare established by the Declarations of Paris and London,

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or until she is compelled to do so by the Neutral Powers."[1]

The sinking of several large liners, including the *Lusitania*, with great loss of life followed, but there was no decrease in the number of vessels entering and leaving British home ports. A number of neutral vessels were torpedoed without warning, still the desired result remained unachieved. The total failure of the submarine blockade scheme was signalled by the fall of Grand Admiral von Tirpitz and the chiefs of his staff, which was preceded by the German submission (formally) to the rightful demands of the United States that the lives of neutrals should not be sacrificed.

We now come to the actual results of the "submarine blockade" of the British coast, which indicate the future possibilities of this new form of warfare. The total number of German submarines, and the proportion available for actual and continuous blockade, has already been stated. This active patrol of approximately seventy-five vessels could not operate as a combined flotilla, in which formation it would have been far more formidable, but was compelled, owing to its paucity in numbers, to divide its units over a wide area. The narrow shipping channels off the west coast of England—the points of convergence of the ocean trade routes—were considered to be the *strategic points*, and several submarines were told off to operate on each of these waterways. The result of the first week's activities has been given by the British Admiralty as seven vessels sunk out of a total of 1400 (of 300 tons or over) which entered and cleared from British ports. Although this could not have

[1] The Declaration of London was never ratified by Great Britain.

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fulfilled the *professed* anticipations of Grand Admiral von Tirpitz, who had loudly proclaimed that "we can bottle her up and torpedo every English and allied ship that nears any harbour in Great Britain, thereby cutting off large food supplies," it nevertheless showed that efficient submarines operating against unarmed merchantmen in narrow and extremely busy waterways may be expected to "bag" about one or two vessels each per fortnight, when the conditions are not altogether favourable for submarine operations and the command of the sea, or surface, remains undisputedly in hostile hands. If the conditions are more favourable for submarines, as they would have been had France been at war with England instead of Germany, the losses of merchant shipping would be far heavier, amounting to about two or three per submarine per week. An indication of this was afforded by the losses of German ships running to and from Sweden during the first few weeks of October 1915, when British and Russian submarines began the long-delayed initiative against German commerce in the Baltic. In this zone no less than twenty-three German ships were sunk in one week (without the sacrifice of life). The average losses in merchant shipping which may be expected in a submarine danger zone, as given above, have been verified by many weeks and months of underwater warfare. It should, however, be noted that the danger to surface ships decreases at a more rapid rate as the hostile submarines are destroyed or disappear. These remarks do not relate to the loss of fishing vessels nor to the use of mines.

Although a coast-line defended by an adequate number of submarines is practically immune from a

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close blockade, points along that coast are liable to bombardment, as a submarine flotilla cannot be in strength everywhere. The English east coast was, during 1914–15, adequately protected by a large number of powerful submarines, but they did not prevent the bombardment of the unfortified town of Scarborough, neither did they succeed in interrupting the raiding ships on their return voyage to Heligoland. In this connection it is advisable to study the speed problem of submarines. The danger of a sudden raid on a submarine-defended coast by hostile surface ships is naturally more pronounced when an enemy base is adjacent, and when the surface ships available are of high speed. A raid by a large battle-fleet or squadron need seldom be expected, because even the most daring commander would hesitate to expose his big vessels to a possible and even probable submarine attack in force or a mine-field, especially if the main opposing fleet remained undefeated.

Although all points on a submarine-defended coast are more or less liable to sudden raid by hostile surface ships from adjacent bases, harbours of importance may be considered less exposed to the risk than unimportant seacoast towns, as the former would always be suspected of harbouring submarines or being defended by mines, whereas an unimportant town on an exposed coast would be looked upon as a safe and easy prey for the guns of surface warships. For this reason it is sometimes advisable to lay mine-fields in the sea *flanking* large seaside resorts which have no strategic or military value, as it is at such points that they are least expected by an enemy.

The bombardment and mine protection of otherwise undefended towns raises vital questions of inter-

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national law. The shelling of undefended towns is prohibited, but as little attention was paid to this cardinal rule of war and of humanity by German warships in the recent operations, it may be expedient from a military point of view to mine the waters in the vicinity of unimportant towns when, by their position or topography, they offer facilities for the disembarkation of an invading force, the temporary interruption of vital rail or other communications, or form a flank to a military force operating farther inland.

A systematic bombardment of an important hostile base has been rendered both extremely difficult and hazardous by the development of submarines and mines. A surface fleet cannot approach within firing range during the daylight without great risk of having several of its largest units torpedoed. At night the fire of a fleet would in many cases be less effective, and the danger of an unsuccessful torpedo attack is only slightly minimised by the inability of the submarine to attack submerged. In darkness or during the half-light of dawn or dusk, submarines can attack in a semi-submerged condition with very fair chances of getting within torpedo range unobserved. What a surface fleet gains in safety during the night it loses by the ineffectiveness of its fire. There is also the increased possibility of an attack by surface torpedo-boats or destroyers, whose activities are almost exclusively confined to the hours of darkness or fog. Mines, both of the contact and special types, are also a great source of danger to a bombarding fleet, especially when the field is guarded, and relaid if occasion demands, by large submarines. These two defences, combined with land fortifications, render a systematic bombardment of a coast base by an

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ordinary surface fleet a very costly operation, and one seldom likely to be undertaken.

New weapons of defence are met by new weapons of attack; and although an antidote for the submarine has yet to be evolved, temporary expedients have been employed in modern naval warfare with varying results. One of the most successful of these is the monitor for coast bombardment. These floating batteries are of such shallow draught that they are almost impossible to hit with torpedoes fired from submarines; and even when struck by torpedoes or mines, their construction is such that they seldom founder. They are, however, quite useless for open sea warfare. The British monitors, used for the bombardment of the Belgian coast and elsewhere, were many times unsuccessfully attacked by German submarines.

A large number of active destroyers minimise the danger of a submarine attack on a bombarding fleet, all units of which should be kept moving at full speed while off the hostile coast or port. The few ordinary surface ships operating with the British monitors avoided hostile submarines by the skilful use of the helm.

This brings us to the facility with which the largest and most modern submarines fitted with guns of steadily increasing size and power can evade a defence fleet and bombard any point on a hostile coast. No exposed seaside town will in time of war be safe from bombardment by hostile submarines. Adequate and specially laid deep mine-fields may prove a deterrent feature to these attacks, but the advantages they offer are somewhat neutralised by the fact that if used solely for the defence of a

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town and not for a strategic waterway, their employment would in all probability destroy the validity of any claim which the town might have under international law to be regarded as *undefended*, and thus immune from bombardment.

The first example of the shelling of a coast town by a submarine occurred on the Lancashire coast of England in 1914, when Whitehaven was bombarded by the 28-pounder guns then installed on the German U-boats. The damage done was slight; but had the guns been of the 9-inch or 12-inch calibre, the destruction of both life and property would undoubtedly have been very great.

There are, however, several difficulties and dangers in the way of submarines attempting a coast bombardment. In the first place, vessels of sufficient size to carry such powerful guns would require a considerable depth of water to enable them to approach the hostile coast in a submerged condition. The necessary stratum of free water under the keel being not less in depth than three times the diameter of the submarine, the free stratum of water above the conning-tower should be equal in depth to the diameter. This calculation is based on the fact that no submarine can steer a perfectly level course when submerged, and that unless there is a considerable reserve of water under the keel it would be impossible for the submarine to sink sufficiently deep to elude pursuit by fast surface craft, or to render herself immune to bombs dropped from seaplanes if the necessity arose. This makes the total depth of water in which a submarine of several thousand tons displacement can operate with safety not less than five times the diameter of the vessel. There are,

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of course, occasions when this approximate rule may be disregarded, but such occasions would be scarcely likely to occur when operating on a hostile coast. Another difficulty which will frequently present itself to bombarding flotillas is the presence of shoals and rocks, the buoys marking the safe channels through them having been removed *or altered* by the enemy, and the channels mined. Yet another danger is the time required by such large submarines to rise from the totally submerged to the light or surface cruising condition before the guns can commence firing. This danger presents itself more forcibly when the submarine desires to sink back into its ocean bed to avoid being attacked by surface craft coming to the relief of the bombarded coast. The speed of surface warships is certain to be greatly increased in the near future; and if, for example, ten minutes was required by the submarine to submerge, a surface warship travelling at 30 miles an hour would be able to cover 5 miles in that space of time. From these few facts the submergence difficulty will be apparent. Judging from recent naval warfare it appears, however, that a bombarding or raiding surface fleet can at times elude all defending patrols and remain uninterrupted on an enemy's coast for several hours. An example of this was afforded by the German cruiser raid on the English east coast. If this, then, is possible by surface warships, its accomplishment by the much more elusive submarine should be comparatively easy.

The older theories pertaining to the attack and defence of trade-routes have been completely revolutionised by the advent of the ocean-going submarine. These under-water cruisers have placed it

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beyond the power of *any* surface navy to absolutely prevent the temporary interruption of one or more of its national trade-routes which pass within the radius of hostile submarines.

Previous to the employment of this type of craft, trade-routes were protected, first, by the certainty which good strategy gave to the supreme navy of ensuring that the fleet opposed to it did not escape a decisive action in order to prey upon the national trade-routes in its rear or on its flanks; and, secondly, by the provision of fast warships for the immediate protection of these routes from the independent commerce-destroyers of the enemy. Where a danger zone was known to exist, as, for example, when a trade-route passes within easy reach of a hostile base of secondary naval importance which was not being closely blockaded, the *convoy system* was employed; and at the converging points of several routes small commerce-protecting fleets were assembled.

The ability of submarines to avoid not only the main battle fleets but also the commerce-protecting vessels of an enemy, enables them to threaten any of the vital trade-routes within their wide radius of action without first defeating a single commerce-protecting warship. If military rather than economic damage is desirable for strategic reasons, such as the prosecution of a war of attrition, the commerce-protecting warships or convoy guards may be attacked in force while their own main fleets remain in undisputed command of the sea. In face of this new danger convoy duty will have to be largely undertaken by specially constructed warships. The collection of a large number of merchantmen into an unwieldy fleet—unwieldy because of the difference in the speed

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of almost every unit—was always a difficult and dangerous operation in the face of an alert enemy: the danger and difficulty has been more than doubled by the advent of the submarine. The mark which a slow-moving fleet so assembled would present to an attacking submarine flotilla is very great. Another point to be noted is that, unless destroyers in large numbers are employed, a convoy guard becomes almost impotent when faced with attack by a numerous submarine fleet; and that if an attack by surface warships is also possible, destroyers become powerless in the face of the heavier guns of the enemy. If fast cruisers are employed their large size make them excellent targets for torpedo attack, and they are prevented from using their high speed as a constant method of defence against under-water attack by the slow speed of several of the ships they are convoying; the speed of any fleet being that of its slowest unit. Submarine mine-layers can strew their weapons in front of a convoy. It thus becomes a fact that the larger and more powerful the convoy guard the greater is the likelihood of successful attack either by submarines or surface warships. The increase in the speed of submarines enables them when acting as scouts to bring intelligence of the speed, composition, and line of advance of a convoy to a main intercepting fleet or flotilla.

If merchant ships were of standardised speed and were organised during the years of peace into more or less homogeneous fleets accustomed to co-operative action in readiness for war, the value of the convoy system would be more than doubled. It is, however, highly necessary that officers of merchant ships should be aware of the tactics of submarines and expert in anti-

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submarine manœuvres. These new theories, which must be almost instantly applied without previous warning in time of war, need systematic training in time of peace.

The question as to what is the best type of surface ship for the protection of commerce against submarines is a very knotty one. A type of large and fast destroyer-cruiser heavily armed with quick-firers would seem to embody many of the essential features, but it should be disguised as a merchantman in order that hostile submarines may be induced to attack, thinking it an easy prey. It is for this reason that armed merchantmen in large numbers offer the best protection for a busy trade-route. They can, themselves, act both as food or munitions carriers and also as patrol ships, for it must be remembered that an armoured warship of the latest pattern and carrying the heaviest guns can as easily be sunk by a torpedo from a submarine as a thin-skinned liner; and that guns beyond the 6-inch calibre are almost useless for beating off a submarine attack. Furthermore, the larger the vessel the less adroitly can it be manœuvred. Therefore size, armour, and heavy gun-power are no answer to the submarine and its torpedoes, but constitute a drawback and also a danger, because they give to a crew a false feeling of immunity; whereas light draught, speed, and rapid manœuvring ability are the qualities to be aimed at, because they aid the surface vessel to ram the attacking submarine or to avoid the torpedoes discharged and await an opportunity to effectively use quick-firing guns or depth-charges. It should be borne in mind by the commanders of all surface ships that the avoidance of every torpedo discharged from a submarine is a tactical victory, first, because

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this is equivalent to the loss of a gun by a surface warship; and, secondly, because it may cause the submarine to expose itself to gun-fire by coming *momentarily* to the surface to correct its aim. A surface ship which causes a hostile submarine to unsuccessfully discharge three or more of its torpedoes has rendered a service to its country, because the stock of these weapons carried by submarines is strictly limited owing to their weight and size, and when exhausted they can usually only be replenished at a base. It is on these voyages to and from a known base that submarines are most easily trapped and destroyed by naval ships and appliances exclusively employed for this purpose.

In the work of coast defence, submarines will play an ever increasing part. During the war between the Central Powers and the Quadruple Alliance, large flotillas of these vessels were constantly engaged in those naval operations which have been aptly described as the *offensive-defensive*. They covered or defended their respective coast-lines and harbours by acting on the offensive whenever the enemy left his base and tried to raid the defendant coast. The rôle of the coast-defending submarine is therefore an offensive and not a defensive one, and it follows that these vessels should not be allotted to each harbour or town along the coast-line to be protected, but should operate in flotillas of convenient size from strategic, well-fortified, and *advanced* bases. To divide a flotilla into individual units would be to greatly reduce its collective fighting quality, for the very essence of submarine warfare is concentration both in numbers and attack,—due regard being paid to the difficulties encountered by submarines

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operating in flotillas, when submerged, owing to their being unable to see or communicate with each other. Various methods of secret submarine signalling are now being perfected by several naval powers.

It has been said that a coast-defence system relying principally upon warships or movable defences of any kind is liable to concentrate, under what is apparently a necessity, at a point which afterwards turns out not to be the enemy's real objective, and thus the coast-line which they were designed to guard is suddenly left exposed. For this reason all coast-defence flotillas should be placed under a separate and responsible command in times of peace as well as war, and should not be considered in any estimate of active naval strength. Nelson in his scheme for the defence of the Thames and the south-east coast of England emphasised the order that the *blockships*, or coast-defence vessels, should not be moved under what might apparently be a necessity. Their positions, which had been carefully chosen after due consideration of all possible contingencies, must not be hastily changed. For these reasons it may be advisable in some countries for large submarines to be built and maintained by local public subscription. In this case they should be placed under the sole command of officers lent by the Government, and should be formed into sections or flotillas.

When considering the position of bases for submarines the port which is the most likely to be the objective of an enemy should not be chosen, but two bases should be made available flanking this point and at no great distance from it. This procedure will, in time of war, prevent an enemy concentrating his forces in front of one hostile port, and will favour

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flank and rear attacks. It also serves to harass the lines of communication if any attempt is made to effect a landing of troops. Where possible, submarine bases should have more than one exit to the open sea, and should be screened from bombardment. A harbour with a broad and deep exit is always to be preferred to one with a narrow or shallow mouth, which might be blocked by an enterprising enemy as at Zeebrugge and Ostend. Places where strong tides or dangerous currents are prevalent should be avoided, but dangerous shoals through which deep channels run in more than one direction are not a deterrent feature, as they form natural defences against hostile attack without special local knowledge. An *advanced* submarine base is essential, as it is the duty of these vessels to delay and harass an advancing hostile fleet; and a series of properly equipped bases on the same coast-line is far better than a single base, as they serve to mystify an enemy and provide lines of attack and retreat, all of which cannot be closed by the strongest and most skilful foe. Above all, these intermediate or secondary submarine bases must be so placed as to conform to the national naval strategy, and, where possible, to command narrow waterways or maritime cross-roads.

Heligoland possessed many of these ideal features: (1) It is an advanced base; (2) is partly a steep-to island with cliffs 176 feet high, and has outlying reefs which form a roadstead with several exits; (3) is heavily fortified against an attack by a surface fleet; (4) is distant about 50 miles from the mouths of the three principal German rivers, the Ems, the Weser, and the Elbe; (5) is an advanced point with immediate access to the North Sea, and is so placed strategically

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as to make a close blockade *by surface ships* of that portion of the German coast, of which it is the centre of defence, a very difficult and dangerous operation. Behind it are the other bases on the same coast-line. The strategic position of Dover, covering the narrow straits in front of it, is another example of a well-chosen base, but in this case the strong tides are a drawback.

It must be pointed out in conclusion that the most excellent naval base can, unaided by a fleet, squadron, or flotilla, only command the surrounding surface which is well within the range of its guns. It cannot prevent the approach or passing of hostile submarines, neither can it, except by the dispatch of mobile forces, dispute the passage of surface ships with certainty of success. Its dormant influence lies in its power to harass the lines of communication of any hostile fleet which passes it. It is therefore apparent that a base is of subsidiary importance to the fleet or flotilla to which it acts as a refuge. Both too little and too much importance can be, and is very frequently, attached to the acquisition or defence of a strategic point. In the words of Colonel May, "A town may be safe without a garrison or a harbour without a guardship."[1]

[1] *Imperial Defence*, by Lieut.-Col. E. S. May, C.M.G., R.A., professor at the Staff College.

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PART V

EFFECT OF THE SUBMARINE ON THE DUTIES OF BATTLESHIPS, CRUISERS, AND DESTROYERS

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I

SUBMARINES AND SURFACE WARSHIPS

WITHOUT attempting to define the primary duties of the various classes of warships in naval operations it may be said that in almost all cases the duties of battleships lie not in the individual action of one vessel but in the united effort of a fleet of them, the main object being to bring to action, under the most favourable conditions, the battle-fleet of the enemy. This is, however, not always the case with cruisers and destroyers, whose duties are more varied, and often include individual or unsupported action. For example, cruisers not only act as the van and rear guards of a battle-fleet, but also as coast-defence patrols and commerce guards. Battle-cruisers have an armament equal or superior to many of the older types of battleships; and their speed is very high. An important part of the work of these vessels is reconnaissance-in-force and the destruction of hostile cruiser screens. Their high speed often gives them the advantage of participating decisively in actions fought in distant theatres of war. Destroyers are needed in great numbers not only for scouting purposes and to defend the battle-fleets and cruiser squadrons from torpedo attack, but also to assist in the protection of coasts, trade-routes, transports, and lines of communication. They have also to form

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flotillas for the attack of hostile destroyers and submarines. Torpedo-boats can only be used with any likelihood of success during the hours of darkness or fog, and their utility has been so diminished (1) by the ability of the larger and faster destroyer to perform, even in the most distant zone of operations, the same work under the cover of darkness, and (2) by the greater certainty with which the submarine can carry out, in all weathers, a torpedo attack during the light of day, that they need scarcely be considered as fighting units of a modern fleet.[1]

Having broadly defined the spheres of activity of the various classes of surface warships, there now remains to examine the effects of the submarine on the work of each class of vessel, showing the enhanced value of one type at the expense of another.

Beginning with the battleship, we find that it can no longer cruise or operate in a theatre of war unless accompanied by destroyers, the presence of these fast and easily manœuvred vessels being absolutely necessary for defence against submarine attack. In narrow seas or danger zones even a brief relaxation of this precaution may result in the loss of the battleship, as was the case with H.M.S. *Formidable* in the English Channel. No fleet-commander can therefore detail one or more battleships for any purpose whatsoever without also sending destroyers, and thus weakening his own anti-submarine defences. A battleship, unaided by small and fast surface craft, cannot fight a submarine, but must use its speed and helm to avoid the attack. A fleet cannot remain at anchor or even come to a temporary standstill *off its own coast-line*, except when effectively screened from

[1] A possible exception being the fast motor-boat variety (40–50 knots).

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torpedo attack, unless, of course, it is far distant from an enemy base and beyond the range of hostile submarines—which can now be reckoned as not less than 4000 miles from a shore or ship depôt. In hostile waters frequented by submarines no slackening in the speed of a fleet, or reduction in the number of destroyers available for anti-submarine tactics, can be allowed. The loss of the British armoured cruisers *Cressy*, *Aboukir*, and *Hogue*, while on patrol duty in the North Sea, was directly due to the temporary absence ahead of the attached destroyer flotilla.

The importance of not risking battleships unless for a decisive object makes it inadvisable for this class of warship to undertake the close blockade of a hostile coast defended by submarines, or to attempt the systematic bombardment of a hostile naval base, unless the vessels used are old ones which can well be spared, as was the case when the almost obsolete protected cruiser *Hermes* was torpedoed off the Belgian coast, notwithstanding the precautions taken to guard Admiral Hood's bombarding squadron from submarine attack. The great risk involved in the systematic bombardment of a hostile naval base has made it almost impossible for a superior fleet to compel an inferior one to leave the shelter of its land fortifications, mines, and submarines, and come into the open sea to fight. Thus the greatest fleet of battleships can be compelled to delay initiative until such time as the inferior fleet may think it opportune to come out and fight. Furthermore, the adroit use of a strong submarine flotilla will compel even the most powerful surface fleet to remain at a considerable distance from the coast-line or base which it is watching. This not only prevents a close blockade

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by surface ships, but also ensures the defending fleet, when it issues from its base, having sea-room to deploy for battle. There is, however, the reverse view; only in certain cases can stationary defences, such as mines, entanglements, and batteries, be considered impregnable to submarine attack, and the commanders of large surface ships anchoring behind such would do well to remember the torpedoing of the Turkish battleship *Messudiyeh* by a British submarine which first penetrated the Dardanelles defences.

Even in a fleet action fought several hundred miles from a naval base the possibility of submarine attack must never be lost sight of; and crippled units in many an engagement will doubtless be given the *coup de grâce* by torpedoes from submarines.

If the wholesale employment of the explosive mine has introduced artificial hydrographical conditions into naval warfare by closing certain areas to navigation, the submarine has rendered the passage of warships between mine-fields or through narrow channels or seas an extremely slow and dangerous operation. In this way, many seas and routes hitherto accessible to surface fleets have been closed by the submarine; and it is only necessary to examine carefully the charts of the world to discover how vast is the total area of this limitation of activity. A powerful submarine flotilla can dominate the English Channel, the Baltic, the Black Sea, the Sea of Marmora, the Caribbean Sea, the Inner Sea, the Bay of Bengal, and narrow seas, straits, and channels, in all parts of the world. Surface warships might sail such seas, but the losses among a fleet operating therein would be so great that it could not long maintain its own position or its lines of communication.

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There are, however, two sides to every question. If narrow seas are more firmly closed than ever to big surface ships, they are certainly more accessible than before to hostile submarines; and as one under-water ship cannot successfully fight another, it will be seen that the navy which closes a sea with the aid of its submarines and mines cannot enjoy the full use of that sea for its own surface ships because of its accessibility to hostile submarines.

When considering the relative chances of an attack by one or more submarines on a single battleship or a fleet, the problem resolves itself into one of position and speed. The modern battleship can travel at the maximum rate of from 20–26 knots an hour,[1] whereas the speed of the up-to-date submarine varies from 18–25 knots on the surface, and from 8–12 knots when submerged. Assuming an engagement to take place between vessels of the highest of these speeds, the submarine would lose ground at the rate of 18 knots an hour if they started equally and the submarine travelled submerged—as is necessary to ensure that degree of invisibility which enables a surprise attack. The manœuvring qualities of the comparatively small under-water craft enable them to rapidly gain ground if the big surface vessels are forced, either by the configuration of a coast-line or the presence on the line of advance of mines, rocks, or shoals, to turn abruptly in a direction previously known to the submarine commanders. For this and other reasons it has become an axiom that the safest course for a surface ship to pursue is to turn her stern to the attacking submarine and maintain the posi-

[1] Only a few of the *very latest* battleships and battle-cruisers can attain a speed of more than 30 knots.

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tion until well out of range, as in this way not only is the speed of the surface ship best utilised and the smallest target presented to the hostile submarine, but any torpedo discharged is deflected by the propeller race. The steering of an erratic course by a big surface vessel is the safest when submarines are known to be in the close vicinity, but their exact position is unknown. This course can be continued until the one or more attacking submarines are astern or abaft-the-beam; or in cases where the speed of the submarines is superior to that of the surface ship.

These remarks do not, of course, apply to ships attempting to ram or fight submarines, but only to big surface vessels endeavouring to avoid attack, in which case the policy is to manœuvre with rapidity so as to throw the attacking submarines abaft-the-beam.

The effect of the submarine on the work of cruisers is but little less drastic than it is on the work of the battleship, although it may be accepted as an axiom that the greater the speed of the surface ship the less the fear of submarine attack. Beginning with those comparatively modern additions to the navies of the world—battle-cruisers—we find that their only advantage over the battleship in anti-submarine qualities is one of about 5–10 knots an hour in speed. This increases the manœuvring ability and aids their avoidance of attack or escape from a danger zone; but they cannot fight submarines with any hope of success, and their high cost and fighting value prevents them being risked except for a decisive object. It can scarcely be conceived that any skilful and enterprising enemy will allow "decisive objects" or points to be exposed without submarine protection to destruction by surface fleets. Or, in

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other words, it will be a cardinal point in future naval strategy to cover the temporary bait of an inferior fleet or strategic point with a strong flotilla of submarines and mines, and in this way force the attackers to endure the loss inevitable if the assault is pushed home.

In the cruiser action off Heligoland the inferior German squadron was covered by a flotilla of submarines, and at the moment when the powerful British battle and light cruisers had triumphed over the enemy and were attempting pursuit to complete their victory, the German submarines by a vigorous offensive, and aided greatly by the presence of mine-fields, caused Admiral Beatty to order the discontinuance of the action owing to the great risk to which he would have exposed his big ships had the attack been pressed to what otherwise would have been an annihilating conclusion.

In the work of coast patrol, cruisers play a prominent part, and it is when engaged on these duties that they are most exposed to submarine attack, as their zone of operations is more often than not in narrow seas and is known to the enemy, who can therefore plan an under-water attack without that element of doubt as to approximate position which frequently veils the movements of a high-sea fleet. Furthermore, ruses which could not well be resorted to in blue water can be advantageously employed along a coast-line. An example of this was the torpedoing of the three British cruisers. In this case the German submarines were concealed behind a fishing fleet, near which was a vessel flying the Dutch flag—thought by the British naval commanders to be engaged in mine-laying.

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On the trade-routes, cruisers have for long been employed as commerce guards, and their duties naturally entail going to the assistance of any merchant ship threatened by submarines. This brings them within range of an enemy whom they have no adequate means of successfully combating, and in addition to finding themselves in a position of considerable danger without a chance of using to anything like advantage their own powers of offensive, they may, quite conceivably, have the chagrin of seeing the protégée to whose assistance they went, torpedoed under their very nose. In most cases the submarine would leave the merchantman and turn its attention to the cruiser, as being, in a military sense, the more valuable quarry. In this way a flotilla of hostile submarines on a trade-route can draw within their range any commerce-protecting warships within easy wireless call of an attacked merchantman.

If the submarine has placed a new and rapidly increasing danger in the path of the battleship and cruiser, thereby fettering their actions and limiting their sphere of operations, the effect of its introduction into naval warfare has certainly had the reverse effect on destroyers, or super-destroyers, enhancing their individual value and greatly increasing the need of navies to be supplied with vast numbers of them. It is to this type of fast and easily manœuvred craft that the larger surface warships and also merchantmen look for protection against under-water attack. The degree of protection afforded by destroyers depends in a great measure on the number of these vessels available, compared with the total strength of the opposing under-water fleet.

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To lay down the rule that for each large surface ship there should be two active destroyers, with two others held in reserve, would be misleading, as this would be an unnecessarily high ratio in the case of a moving fleet, but only what is actually required by one or two big ships operating in a danger zone. In all estimates of this nature there must, however, be included the large number of these vessels required for service in the flotillas almost exclusively employed in submarine hunting, those engaged with mine-sweeping fleets, and on the important trade-routes. In this latter work there is no finality to the number which may be required, as allowance must be made for those in dock or on the voyage to and from the trade-routes. In addition to all these there must be provided vessels for coast and harbour defence, and for dispatch carrying and scouting.

From this it will be apparent that whereas the spheres of activity of the battleship and cruiser have been curtailed, those of the destroyer have been enormously increased. It is, however, not the present type of vessel which will be used in the future for anti-submarine warfare; for although they possess many of the essential qualities for such work, they lack the necessary armament to compete with the heavy surface guns on the submarines of the very near future, and their sea-keeping abilities are scarcely sufficient for patrol duty on distant trade-routes.

Previous to the advent of the submarine, destroyers were almost exclusively used for scouting, and to keep close watch over hostile coasts and harbours. It was on the intelligence brought by these vessels that battle-fleets acted. Now, however, much of this delicate work is performed by the more invisible

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submarine; and as proof of the efficiency of these new naval scouts, Commodore R. B. Keyes, C.B., R.N., says in one of his dispatches: "These submarines have since (1914) been employed on the enemy's coast in the Heligoland Bight and elsewhere, and have obtained much valuable information regarding the composition and movement of his patrols." It was the intelligence brought by the submarine officers which enabled the British cruisers to come up with the German light squadron on 28th August 1914. For such duties as these the submarine has partly superseded the destroyer, thus releasing numbers of these fast surface craft for duty elsewhere. In this connection it must also be noted that the employment of submarines for scouting purposes releases not only a certain number of destroyers but also cruisers, for when surface scouts are employed for watching a hostile fleet or base they must be able to fall back on a supporting cruiser squadron or patrol if attacked by superior force. This does not necessarily apply to scouting submarines, which can attack "superior force" with a likelihood of success increasing with the size of the hostile ship or fleet, it being out of all proportion easier for a submarine to torpedo a battleship or cruiser than a destroyer or a torpedo-boat. If the submarine scouts are pressed to disadvantage they can escape capture or destruction by total submergence. It is, however, advisable, when economy of surface ships is not vitally necessary, to support the scouting submarines with both cruisers and destroyers, as it is only in this way that any check can be placed on the activities of hostile submarine scouts, which can easily elude a line or lines of under-water opponents.

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The dangers to which large cruisers are exposed when guarding trade-routes accessible to hostile submarines have already been shown, and these dangers, to which there is no reliable antidote, will cause the larger, faster, and more heavily armed destroyer of the future to be almost exclusively employed for the protection of commerce. In the same way these vessels will be largely used for coast patrol work. The ability of the super-submarine to rise from the depths at unexpected points along a coast-line and commence the bombardment of exposed towns with comparatively heavy guns, necessitates a very numerous surface patrol, composed of vessels possessing not only high speed to enable them to steam quickly to any given point within their radius, but also guns of sufficient power to destroy with certainty the raiding submarine should it be unable or unwilling to seek safety by a rapid dive below the surface. The draught of coast-defence destroyers should be as shallow as is found to be compatible with safety and seaworthiness in order to render them as immune as possible to torpedo attack, and their speed and manœuvring abilities should be as great as science and engineering can devise. With these qualities a numerous flotilla would prove a dangerous enemy to submarines, and there would, doubtless, be many occasions in future warfare when the feat of H.M.S. *Badger* (a destroyer of 780 tons, speed 32 knots), which rammed a German submarine in October 1914, might be repeated; or that of the light cruiser *Birmingham*, which first destroyed the periscope by gun-fire and then rammed the U15, in August 1915; and the more remarkable achievement of the little collier *Thordis*, which rammed a German submarine on 28th

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February 1915. In all cases where a submarine has been run down the bows and keel of the surface vessel have been damaged, necessitating an immediate return to dry-dock for repairs. This would suggest the reintroduction of the old ram, so shaped as to be of use against under-water craft, in the super-destroyers of the immediate future.

That the submarine has quite superseded the ordinary surface torpedo-boat is evinced by the fact that whereas the construction of submarines for the navies of the world has assumed extraordinary proportions, millions sterling being spent annually on the acquisition of these vessels, comparatively few surface torpedo-boats have, for some years, been built.[1]

The hour of the torpedo came with the perfection of the submarine. These subsurface vessels are ideal torpedo carriers, for they can approach within range of a hostile warship quite unobserved even in the full light of day, whereas the older surface torpedo-boats could only attack with any hope of success under cover of darkness or fog. In order to be reasonably sure of hitting, it is necessary that a torpedo should be carried to within at least 1000 yards of the object aimed at before being discharged, and it will be easily realised how difficult and dangerous this operation was for a small surface vessel unless covered by fog or darkness. A ship or fleet moving at night without any lights showing, presented the almost insuperable difficulties of unknown speed and exact position to an attacking surface torpedo-boat, which might at any moment be discovered by the searchlight of the enemy. These difficulties reduced the rôle of the

[1] With the exception of the motor-boat type.

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surface torpedo-boat to one of surprise attack on a stationary ship or fleet at night or in fog; and such conditions so seldom occur in war that their value as fighting ships was reduced to a negligible quantity. On the other hand, a submarine can attack a moving ship or fleet in the full light of day with chances of success varying with the submerged speed of the submarine compared with the position and speed of the enemy. One of the limitations—imposed by the periscope—on under-water craft is the impossibility of a *submerged* attack during darkness or fog, but the high surface speed now obtained by these vessels enables them to usurp the duties of the ordinary torpedo-boat in this respect, and carry out an attack *on the surface* with chances of success equal, if not superior, to those of the surface boat. Submarines can, when attacking in the darkness or fog, sink to the semi-submerged, or awash, condition, with only the conning-tower above the surface, and in this condition they present but a small target to hostile gun-fire.

When carried by surface vessels the value of the torpedo as a naval arm is undoubtedly very small. Admiral Sir Reginald Custance calculated that out of two or three hundred torpedoes fired during the Russo-Japanese War only 5½ per cent. made effective hits, and only 2 per cent. were effective hits against ships in motion. If any similar calculation, based on the recent naval operations in Europe, ever becomes possible, it will, doubtless, be found that when carried by submarines the torpedo is a much more effective and reliable weapon, owing to the ability of under-water craft to effect a surprise attack in almost every instance, and to carry the torpedo to within much closer range before discharging it.

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Modern submarines of several thousand tons displacement are, however, being armed with heavy naval guns, in addition to a large number of torpedoes. This will enable them to carry on offensive warfare on the surface as well as when submerged, with the great strategic and tactical advantage of being able to choose their position almost unhindered by the surface fleets of the enemy. In this way they are falling under the inexorable stress of the logic which brings them into the same category as the cruiser and the battleship. This all-round increase in the size, speed, and armament of submarines has enabled them to undertake duties beyond those of torpedo-boats, and hitherto performed by destroyers, gunboats, and cruisers. They now act as scouts and advance guards; are formed into special flotillas for coast defence, and for the protection of trade-routes and naval bases; they are used for the capture and destruction of hostile merchantmen; the bombardment of seacoast towns; for maintaining a close blockade; for attacks, unsupported by surface ships, on moving fleets and cruiser patrols, troopships, and convoys; for forcing the passages of straits and channels; laying explosive mines; covering the transportation of troops; acting as a naval flank to an army operating on an exposed coast; harassing the advance of a hostile fleet; giving the *coup de grâce* to wounded units of a battle-fleet; for attacks on individual warships on special duty; for carrying information and dispatches; for carrying supplies to a beleaguered naval station; for guarding the lines of communication of a fleet; and for many other duties which were hitherto performed by cruisers. If this is the result of the submarine's first trial in actual naval warfare, is it not vitally necessary that

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the old theories of sea power should be revised in the light of modern fighting and modern science, and that nations aspiring to naval strength should consider well the warning of many British and foreign naval officers of high rank and attainments? It will be around the construction and evolution of this type of warship that engineering and naval interest will in future centre.

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PART VI

THE SCOPE AND LIMITATIONS OF SUBMARINE ATTACK AND DEFENCE

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I

SCOPE AND LIMITATIONS OF SUBMARINE ATTACK

WHEN considering the scope and limitations of submarine attack—or the possibility of hostile submarine activities in a given theatre of war—the four main questions to be answered before any decision can be arrived at are—(1) the distance of the theatre of war from a hostile shore base; (2) the possibility of the enemy being able to maintain depôt ships within, or near to, the actual zone of operations; (3) the hydrographical features of the theatre of war; and (4) the number and radius of the submarines available to the enemy for offensive warfare.

If the distance dividing the nearest hostile shore base from the actual zone in which the submarines would have to operate is as great or greater than the independent surface range of the submarines available to the enemy, then little has to be feared, unless the enemy is in a position to maintain surface depôt ships at a point or points nearer to the actual zone of operations. This can only be successfully accomplished by a navy superior to the enemy in surface ships; for floating depôts, maintained on the line of communications of a submarine flotilla, must

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not only be adequately guarded against attack by a surface fleet, but must also be protected from hostile submarines. The importance of such depôt ships to submarines going to and from their shore base and a distant zone of operations can only be likened to the food depôts left by exploring parties in the frozen seas. They are a matter of life or death, and even their temporary removal would probably be fatal to several vessels, which would find themselves stranded without fuel or stores. There is, however, always the possibility of submarines making use of neutral ports for obtaining supplies, or of being secretly supplied with them from friendly or even strictly neutral coasts. This latter method would, however, be too risky to be absolutely relied upon as a necessary link in the chain of communications, and need only be considered in cases where the country giving such assistance is ready, from both the political and military point of view, to throw in her lot with the enemy.

In order to make this base-problem clear, it may be pointed out that in the recent fighting the nearest German submarine bases were at Heligoland and Zeebrugge, while the zone of operations, so far as the so-called blockade was concerned, was off the north and south-west coasts of England. The distance in either case was approximately 900 miles, which necessitated the hostile submarines making a voyage of 1800 miles to and from their base whenever they needed supplies, as there was no possibility of maintaining depôt ships at any point nearer to the actual zone of war, owing to the general superiority of the British Navy. The maximum range of the German submarines was approximately

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8000 miles, but from this had to be deducted the 1800 miles voyage out and home to Heligoland, which left only 6200 miles for the actual offensive, and as these vessels could not remain at sea for periods much longer than one month, owing to their lack of food and munitions, and to the strain on the crews, their time on the British coast was practically limited to about two weeks. The total number of submarines available at one time was between 100–150, and of this number less than half could be simultaneously employed in the offensive operations, for the reasons given on previous pages. Crippled units had no near-by base to which to run for repairs, and were consequently an easy prey to the destroyer; and as the routes taken by these vessels on their frequent and necessary voyages to and from Heligoland were known to the British anti-submarine fleets, traps with hydrophones, nets, mystery ships, mines, lighted barrages, aerial bombs, and other appliances soon proved effective in reducing the number of submarines available to the enemy.

From this necessary repetition of what was said in an earlier chapter will be seen the importance of base-power in submarine warfare. Had the distance between Heligoland and the English west coast been much greater than it was any German submarine, which succeeded in reaching it, would have been played-out in a few days and useless for offensive operations; whereas had Germany possessed a shore depôt at a point half-way between Heligoland and the actual zone of war the efficiency of their submarine fleet would have been more than doubled.

The hydrographical features of the theatre of war, given at the beginning of this chapter as one of the

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essential factors for consideration, refer to those problems of submarine navigation occasioned by shallow water, strong tides and currents, and treacherous shoals. The distance between a base and a zone of operations may be very short, but the voyage there by submarines may be extremely difficult and dangerous, or even quite impossible. The distance from Malta to the Sea of Marmora was not great, but the intervening passage of the Dardanelles made the voyage to and from there by British submarines one of considerable difficulty and danger. The Baltic is an ideal theatre of war for submarines during the summer months, but is frozen over during the winter. Certain portions of the coast-line of the Gulf of Florida and the Caribbean Sea are ideal for defending submarines with a thorough knowledge of the shoals and tides, but difficult and dangerous playgrounds for attacking vessels without the necessary local knowledge. The Goodwin Sands form a very efficient defence against submarines threatening the south-east coast of England, but present no difficulties to a flotilla operating from that coast. These are just a few examples, selected at random, which illustrate the influence of hydrographical features on submarine operations.

All these conclusions reassert the old importance of base-power, which, since the advent of steam, has always been one of the dominating factors in naval warfare, and is now even more important than ever, owing—(1) to the need for submarines of frequent renewal of fuel, ammunition, and stores, and a change of crews; (2) to the fact that with the introduction of the under-water fighting ship the blockade and

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bombardment of naval bases has become almost impossible; and (3) to the great advantages conferred upon navies possessing these bases in close proximity to all possible theatres of war, not least among which is the ability thus secured to use its submarines to the utmost possible advantage.

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II

PROBLEMS OF NAVIGATION

SUBMARINE navigation presents three difficulties not met with in surface navigation. The first of these is the greater effect of cross-tides or currents on totally submerged vessels than on those floating on the surface. This makes deviation from the correct course by submarines when travelling under water more likely to occur unnoticed than is the case with surface ships, and the impossibility of taking observations or bearings while submerged necessitates an occasional return to the surface during the daylight for this purpose alone.

The second difficulty is that large submarines require a much greater depth of water in which to submerge than is sufficient for the safe progress of surface ships of the very largest size. In places where the depth of water is at least 40 to 50 feet, a thirty thousand ton battleship can navigate with comparative safety, whereas a fifteen hundred ton submarine requires from 60 to 80 feet of water in which to manœuvre with safety when submerged. Happily for the submarine this ratio of depth to displacement does not increase in proportion, otherwise the future of this type of warship would be limited to comparatively small vessels. With a two or three

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thousand ton submarine 100 feet of water is sufficient for submergence, and whatever, in reason, is the size of future vessels, not more than 150 to 200 feet of water should be required for submergence.

There is, however, a different aspect to this problem. Although from 60 to 150 feet of water is considered comparatively shallow, and no difficulty need be anticipated in the navigation of submarines in the broad ocean, or even in comparatively narrow seas, there are many coasts, channels, and waterways in which this depth is seldom, if ever, found. When such places have to be passed, submarines are compelled to come to the surface, or else to run submerged at a much greater risk; and when such strategic points are closed by mines and nets defended by destroyers, the difficulties and dangers of submarine navigation make the risk only worth taking when *vital* issues are at stake. In hostile waters, where a submarine would be compelled to remain on the surface owing to the extreme shallowness, it is impolitic for this type of vessel to be employed. This rules out very shallow coasts from bombardment or close blockade by submarines, except when there is no fear of interruption from surface ships. In places where a shallow bar exists between a submarine fleet and a zone of operations, this bar should either be held by surface ships in order that the submarines may cross it in safety, or when this is not possible, the dangerous patch of water should be traversed by the submarines at night at various points simultaneously. If such a place is strongly held by hostile destroyers, it is extremely risky for submarines to attempt the passage. Examples of such difficulties to submarine navigation are afforded by the approaches to portions of the

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German, English, American, African, and Australasian coasts.

The depth-danger could be greatly minimised were it possible to ensure a perfectly level horizontal course when submerged, the tendency of all submarines being to travel forward in long up-and-down-hill swoops. Much has, however, been done during recent years to reduce these yaws, but in rough weather the rise and fall of a submarine will sometimes amount to many feet. The following from a British dispatch affords a clear idea of this difficulty. "During the exceptionally heavy westerly gales which prevailed between the 14th and 21st September (1914), the position of the submarines on a lee shore, within a few miles of the enemy's coast, was an unpleasant one. The short, steep seas which accompany westerly gales in the Heligoland Bight made it difficult to keep the conning-tower hatches open. There was no rest to be obtained, and even when cruising at a depth of 60 feet the submarines were rolling considerably, and pumping, i.e. *vertically moving, about 20 feet.*"

The third difficulty, to put it summarily, is a series of small difficulties, one of which is the already explained impossibility of cruising submerged during the hours of darkness; another is the restricted range of the periscope, which seldom gives a horizon more than 6 to 8 miles distant, and which is much more frequently reduced by mist or sea to about 4 or 5 miles. Yet another is the difficulty of combined action by submarines, owing to the lack of a means of intercommunication when submerged—this difficulty is, however, being rapidly overcome by a variety of methods; and, lastly, there come those petty diffi-

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culties entailed by the entire absence of sound as a guiding factor combined with the restricted arc of vision. If any reader wishes to realise what this latter difficulty means, he need only walk along a street looking through a pair of opera glasses and with cotton wool stuffed tightly in his ears. Although this might magnify the difficulty somewhat, it gives a good idea of the effect of the loss of hearing combined with restrictions on the eyesight as applied to locomotion.

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III

SUBMARINE TACTICS

THE strategic scheme of a submarine fleet must conform to the general naval plan of action, which in turn forms one branch of the national strategy, planned in time of peace and executed in time of war. In what circumstances these vessels undertake a task which their advantage of submergence make them specially qualified to perform, either in offensive or defensive warfare, has already been shown in previous pages. There now remains to be given a few of the guiding principles of *submarine tactics*, for it is upon the carrying out of these evolutions that the success or failure of an attack frequently depends. With surface ships a tactical error may sometimes be retrieved by accurate gun-fire, but with submarines operating submerged a tactical error more often than not means a failure to get within torpedo range.

Although there are a few guiding principles, submarine tactics consist, principally, of individual stratagems, the object of which is to induce the enemy to come unsuspectingly within torpedo range. The provision of heavy naval guns in modern underwater craft gives them a double rôle. When a hostile warship of large size and power is sighted, the attack must be delivered in the submerged condition with the torpedo; but if an enemy torpedo-boat, troopship,

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or armed merchantman comes within range, then the submarine can economise its comparatively small stock of powerful torpedoes and use its surface guns. The question as to which of these two modes of attack—submerged torpedo or surface guns—should be chosen in any given instance depends in a great measure upon the two factors—(1) the size and armament of the enemy ship, and (2) the distance from which the attack has to be delivered. When the object of attack is a large and powerfully armed ship, the torpedo is the weapon to be used, as it would, manifestly, be suicidal for the submarine to expose herself on the surface to the heavy gun-fire of a big ship, which offers the best possible target to submerged torpedo attack. Where the object of attack is, however, a large but poorly armed surface ship, such as a transport or armed merchantman, the submarine will have the choice of either a surface or a submerged assault, and will be guided by the second factor, i.e., *the distance from which the attack has to be delivered.* If the transport is a comparatively slow vessel and the position of the submarine is such that she can easily reach torpedo range on her submerged speed, then the only question to be answered by the submarine commander is whether the general naval plan makes the transport (laden or unladen) worth a torpedo. Should the transport be a fast moving ship and the position of the submarine such that she could not get sufficiently close by travelling submerged to discharge a torpedo with a reasonable chance of success, then the under-water vessel is justified—unless contrary to the general naval plan—in utilising the additional speed she can gain by travelling on the surface, and the longer range of her guns. In

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cases such as this—surface attacks on transports or armed merchantmen—care must be taken by the submarine that no surface warship is hidden by the intervening hull of the object of attack, or that a really powerful warship is not disguised as a harmless transport. When the object of attack is a destroyer, the difficulty of getting and keeping within range is the primary factor to be considered. A torpedo attack on a destroyer seldom succeeds unless delivered at very close range—a position extremely difficult to attain. A surface attack should be refused unless the commander of the submarine is sure that the opposing destroyer only carries guns of inferior power and range to his own, in which case he should endeavour to secure a favourable tactical position before opening fire,—preferably while in an awash condition,—always remembering (1) that the submarine presents a smaller target to the guns of the destroyer than does the destroyer to those of the submarine; (2) that advantage should be taken of the longer range of his own guns to keep just out of range of those of the enemy as long as possible; and (3) that if the destroyer seeks to get to close quarters and a favourable opportunity occurs, a torpedo can be used. Care must be exercised to frustrate any ramming tactics, and to avoid torpedoes from the *movable* tubes of the destroyer. The worst conditions under which submarines can operate are "smooth sea and low visibility," and their most dangerous opponents are deep laid mine-fields, mystery ships, super-seaplanes, and fast craft armed with guns, hydrophones, and depth-charges.

Among the general principles which may be noted is that any manœuvre entailing a change from the *surface* to the *submerged* condition within range of

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the enemy should be avoided. A surface attack on a more powerful enemy should never be undertaken, owing not only to the superiority of gun-fire, but also to the vulnerability of the submarine when on the surface compared with the armoured surface ship. The great tactical advantage of the submarine is its ability to submerge, and no *surface* action should be accepted unless the chances are distinctly in favour of the under-water craft. When a submerged attack is being carried out and the torpedo range has been reached *unobserved*, a torpedo should not be discharged until the range has been reduced to a distance from which a hit is almost certain, and then two torpedoes can be launched almost simultaneously, the second varying a point or two in the direction the object of attack is moving. It is useless to waste a torpedo on a dead-astern attack on a moving ship. One of the most dangerous positions for a submarine is close to and dead on the line of advance of a fast moving ship which is aware of its presence there. A torpedo discharged at a vessel bows-on is usually wasted. The most favourable position for a submerged attack is a point under 800 yards off the port or starboard bows of the object of attack. A dangerous time for the submarine is at dusk in the presence of an alert and mobile enemy, as the fading light makes navigation by the periscope almost impossible some little time before darkness enables the submarine to return to the surface with comparative safety.

The difficulty of attacking a surface warship steaming at right angles to the course of the submarine will be clearly understood by referring to the following diagrams. The first shows an attack on a warship travelling at 20 miles an hour, such as a big

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battleship or a cruiser. Any increase in the speed of the surface vessel not only adds to the difficulty of the attacking submarine, but also alters the angle at which the attack must be made. This feature is shown in the second diagram, which illustrates a submarine attack on a vessel steaming at 30 miles an hour, such as a fast destroyer or fleet scout. On the other hand, a decrease in the speed of the oncoming surface vessel tends either to make easier the task of the attacking submarine, or else to increase the distance from which the attack can be delivered. This is shown in the third diagram, which assumes

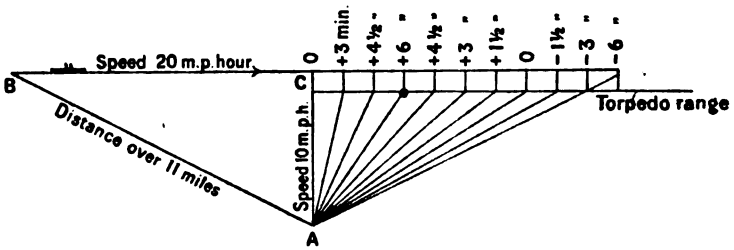

FIG. 1.

the speed of the surface vessel to be only 15 miles an hour, such as a merchantman, troopship, food-ship, collier, or old warship.

Fig. 1 represents a submarine attacking a hostile warship (or fleet) steaming at 20 (statute) miles an hour. AB is the line of vision. The submarine sights the warship at a distance of just over 11 miles on her port bow. BC shows the hostile vessel's course, which is 10 miles to point marked C, and each division beyond equals one mile.

Directly the submarine, which is assumed to be lying in an awash condition, sights the object of attack, she totally submerges and steers forward in

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the direction which will be most advantageous at a speed of 10 miles an hour. The gain, or loss, of the submarine at various angles is indicated by the signs + or − prefixed to the minutes marked at each mile.[1]

The black dot shows the most favourable point of attack. It will be noticed in the table that the two vessels would meet at point C, but for many reasons this is not the best point of attack. The gain of about six minutes on the longer course enables the submarine not only to manœuvre into

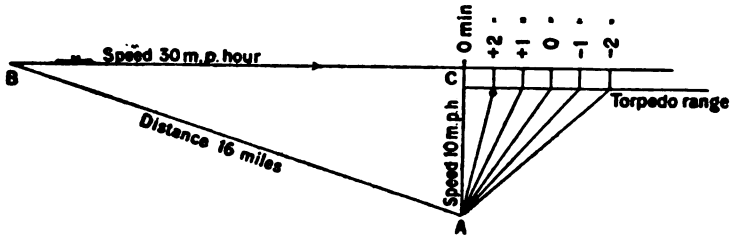

FIG. 2.

the best possible position for the attack, but also to discharge more than one torpedo if necessary.

Fig. 2 shows the extreme limit at which a submarine could, with reasonable chances of success, attack a destroyer, or other vessel, steaming at 30 (statute) miles an hour, having sighted her at a distance of 16 miles in the position shown by the line of vision AB.

The distance to C is 15 miles for the surface vessel, and 5 miles for the submarine. Here, again,

[1] As it is almost impossible for a submarine, when totally submerged, to steer a perfectly straight course, the numbers show the *approximate* average gain or loss on each mile. It must also be remembered that the submarine in actual practice need only reach the torpedo firing line.

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the two vessels would meet; but the most favourable point of attack is shown by the black dot—where the submarine has gained two minutes.

Fig. 3.—The submarine sights the object of attack at a distance of 14½ miles, in the position shown by the line of vision AB. The surface vessel has a speed of only 15 miles an hour (merchantman). In this case the surface vessel accomplishes the 10-mile journey along BC—arriving at point C twenty minutes in advance of the submarine. The

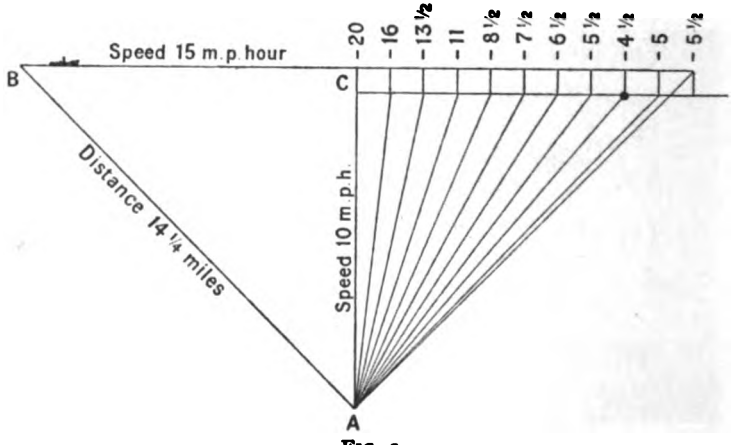

FIG. 3.

table shows how the submarine by changing her course and "throwing" the surface vessel on her beam, gradually reduces the loss, until, at the point marked with the black dot, she is but 4½ minutes behind. At this distance she could fire her torpedoes at long range, with some likelihood of success.

Although these diagrams show approximately the extreme limits of the lateral attack, a submarine could, of course, proceed for some distance on the surface at a much faster speed; but considering the

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rate at which the two vessels would be approaching each other, the submarine which attempted it would run considerable risk of being detected, and thus destroy her chances of a successful attack. Considering also the time lost in sinking from the "light" to the totally submerged condition, on coming to close quarters, the gain in time would not amount to as much as the speed would indicate.

These charts are drawn and calculations made assuming the following points:

(1) The weather—fine and bright.
(2) Not taking into consideration strong tides, currents, etc.
(3) The enemy on the alert.
(4) Submarine waits at point A in awash condition.
(5) Owing to 1, 2, and 3 above, the submarine travels from point A on all courses in a submerged condition.[1]

The above figures and diagrams indicate the most favourable submerged courses for a right-angle attack on a single hostile ship or fleet. Concentration of attack on the leading ship of a line or column is generally advisable, except when the object is to divide the surface fleet (see previous pages). In most cases the largest ship within easy range offers the best chance for a successful attack. Combined action by a flotilla of submarines in a narrow tactical area is extremely dangerous unless adequate provision has been made beforehand to avoid the possibilities

[1] These calculations are repeated from the author's previous works, *Submarines of the World's Navies* (Francis Griffiths) and *The Submarine in War* (Daily Telegraph War Book).

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of collision between different units, and the danger of a torpedo discharged from one submarine, and missing its object, accidentally striking another.

It has been said, with a foundation of truth, that submarine cannot fight submarine. There are, however, occasions when the exception proves the rule. Among the many individual stratagems which submarines have successfully employed during the recent naval operations, was one which had for its object the luring of *hostile submarines* to destruction. A powerful steam-trawler was employed to tow a submarine by a wire hawser made invisible by being placed below the surface. The appearance created was that of a large steam-trawler engaged in fishing operations. In this way a danger zone of hostile submarines was entered. When stopped by one of these vessels which came to the surface to send a bombing party on board, the towed submarine let go its hawser and torpedoed the hostile submarine lying unsuspectingly on the surface. Another ruse adopted by German submarines was to rig up sails on several units of a flotilla in order to represent a harmless fishing fleet, while others were cruising in the vicinity, submerged and ready to torpedo any British patrol ships which might approach to investigate.

These individual stratagems could be multiplied almost indefinitely, but would serve no useful purpose. In all impromptu attacks the exact method or manœuvre must be arranged to suit the circumstances, and is more a test of the ingenuity, resource, and daring of a commander than the solution of purely tactical problems. It is very seldom that two such attacks can be carried out alike.

Any tactical system on which submarine attack

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and defence is in future planned must of necessity be so arranged as to afford the best series of counter-strokes to the tactics of the various classes of surface warships; and any intricate methods involving the close co-operation of several submarine units when submerged must prove impracticable until such time as science devises a perfect means of inter-communication between under-water ships.

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PART VII

THE EVOLUTION OF THE SUBMARINE MINE AND ITS INFLUENCE ON THE CONDUCT OF NAVAL WAR

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I

THE HISTORY OF THE SUBMARINE MINE AND ITS EFFECT ON NAVAL WAR

THE large number of vessels—both warships and merchantmen—destroyed by submarine explosive mines, as compared with those sunk by gunfire, in the American Civil War, the Russo-Japanese War, and more recently in the Great European War, draws attention to the whole question of the use of mines in naval warfare. They are essentially a submarine arm, and their scientific use forms one branch of the new under-water science which is revolutionising the art of naval war and the older theories of sea power.

When Admiral Sir David Beatty broke off the victorious action of the British cruisers in the Heligoland Bight it was because of the presence ahead of his squadron of hostile submarines *and mines*; and other instances have been given in previous chapters showing the artificial hydrographical features produced at will by the laying of these weapons. The aid that submarine mines afford to a naval force acting on the offensive-defensive against a superior enemy has also been shown; but in order to obtain a clear understanding of their effect, both practical and moral, it is necessary to realise the great losses they have occasioned to surface fleets during

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the naval wars of the last half-century. To this end a résumé will be given here of the history of the submarine mine and its influence on modern naval warfare, some of the earlier facts being drawn from a technical treatise which was partly responsible for the awakening of the German naval authorities to the value of the submarine mine as an *offensive* as well as a *defensive* weapon in the years preceding the Great War.

This treatise begins with the assertion that "the submarine mine is likely to assume in the future a far greater importance in naval warfare than has hitherto been the case. To-day it is no longer an auxiliary, but a self-contained naval arm, and for some time the navies of nearly all sea powers have turned their attention to improvements in its construction, the training of the personnel, the equipment of specially built transport vessels, and the study of the best means of repulsing mine attack. The immediate cause of this awakening may be traced to the experience gained during the Russo-Japanese War, when nearly the same number of vessels were destroyed by mines as by torpedoes and artillery combined. Indeed, the destruction which this simple and comparatively inexpensive weapon is capable of causing, whether for purposes of defence or attack, cannot be excelled even by large battleships. This has been chiefly due to the progress attained in the scientific development of explosives and mechanics. Thanks to recent advancement in technical knowledge it is now possible to substitute for slow-burning gunpowder, modern high explosives with an enormous shattering power, whilst the resources of modern mechanical engineering have made possible the

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construction of an automatically controlled submarine mine equally suitable both for defence and attack.

"The first introduction of the submarine mine, torpedo (and submarine boat) of the present day dates back to the latter part of the eighteenth century. After having devoted himself, during the years 1771–5, to the construction of a submarine vessel for carrying and exploding a bursting charge under ships, David Bushnell, a native of Connecticut, America, was the first to successfully accomplish this object. In the year 1776 a submarine vessel, constructed by Bushnell and commanded by Sergeant Ezra Lee, attacked the *Eagle*, a British ship of the line of 64 guns, anchored off Governor Island. Lee succeeded in getting quite close to the enemy's ship without being discovered, but failed to place his mine under it, and was obliged to retire without having accomplished his object. The gunpowder charge employed on this occasion was fastened to a spar which was attached to the bows of the submarine, and could be adjusted as desired. By this means the charge could be placed under the hull of the vessel attacked. The mine had sufficient buoyancy to remain under the vessel, and was held in position by a screw. It was fired by means of a clockwork mechanism which could be set to any time desired. The same boat made two further unsuccessful attacks on British men-of-war in the Hudson River, where it was ultimately sunk with the vessel on which it was being transported. In the following year Bushnell constructed a drag-torpedo, which was successfully used against the British frigate *Cerberus*. About Christmas he attacked the British fleet outside Philadelphia with a number of drifting torpedoes.

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Although these caused no serious damage, they created great consternation and alarm in the English squadron. This was the last of Bushnell's exploits in connection with submarine warfare. He died in Georgia in 1826. Meanwhile Robert Fulton had tried to interest the French Government in Bushnell's idea, and in 1797 he approached Admiral Dacres in the matter. This gallant officer, however, did not conceal his contempt for 'cowardly' methods which, in his opinion, might perhaps appeal to pirates and privateers, but were beneath the notice of the sailors of the French Navy; and with words to that effect Fulton's proposal was promptly rejected. He received a more encouraging hearing from Napoleon, who was less scrupulous than his chivalrous admiral, and, moreover, was glad to welcome any plan for crushing the naval supremacy of England. In the summer of 1801 the Emperor placed a small vessel for experimental purposes at Fulton's disposal, and the latter actually succeeded in blowing it up by means of a torpedo charge of 20 lb. of gunpowder which he laid personally from a submarine boat. Napoleon seems, however, to have recognised the futility of challenging the English fleet in open fight, and the experiments were discontinued. Fulton therefore went to England under the assumed name of Francis, and in 1804 his submarine after extensive trials was ultimately reported against by a commission appointed by William Pitt. A demonstration of its utility in an attack on the French squadron lying off Boulogne was, however, allowed him, and Fulton succeeded in exploding two drifting torpedoes which, owing to their position on the surface, did not effect their purpose. In order to provide the confinement, so necessary for develop-

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ing the full explosive effect of gunpowder, Fulton then had his torpedo altered to explode under the ship's water-line, and on the 15th of October 1805 he successfully destroyed, off Deal, the Danish brig *Dorothea*, by an improved torpedo charged with 170 lb. of gunpowder. This feat created a great sensation, and gave rise to serious misgivings in England, where people began to recognise that the wooden walls of national safety, hitherto regarded as invulnerable, were in danger. Some advocated withholding all financial support in order to prevent Fulton improvements, and others are even said to have offered Fulton considerable sums to abandon his invention. Such offers, if ever made, were, at all events, never accepted, and ultimately Fulton turned for support to the United States. This was at once forthcoming, and in 1807 he blew up a disused vessel in New York Harbour to demonstrate the merits of his method. Strange to relate, Fulton, who subsequently, in 1809, built the first steamship on the Hudson, and has since become famous as the pioneer of steam navigation, always considered the torpedo as an invention of infinitely greater importance. His sanguine confidence in its future appears from his letters of that period, in which he emphasises the importance which, in his opinion, the torpedo was destined to attain in naval warfare, and declares his belief that the torpedo (really a mine) would eventually render the command of the sea impossible. In one of his letters he said: 'Thousands have witnessed the steamboat going ahead at a good pace; that's why they believe. But they have not seen a man-of-war destroyed by a torpedo; therefore they do not believe that it is

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possible. We cannot expect everybody to possess sufficient knowledge of physics or sufficient mental power to apply ideas and execution to cause and effect. In actual practice, should we find ourselves at war, and the enemy's men-of-war appear in our seas, I would show the world, provided the Government supplied me with the necessary funds, that we possess better and cheaper means of defence than is dreamt of.'

"One of Fulton's contentions at least was correct, viz., that torpedoes and mines constitute an effective and inexpensive means of defence. This still holds good to-day, since the cost of a single modern cruiser which, alone and of itself, would prove entirely inadequate for harbour defence, will provide a sufficient number of mines to bar access to any harbour. In this manner the smaller Powers are in a position effectively to defend their harbours against the powerful fleet of a stronger enemy.

"Although the Americans did not succeed during the war of 1812–13 in inflicting very serious loss on the British fleet by mine and torpedo, they managed to create a very strong feeling against this kind of warfare, denounced by an English contemporary as an 'inhuman and savage proceeding.' The introduction of electric firing, previously intended but never carried out by Fulton, soon proved the means of considerably enhancing the possibilities of the submarine mine. In 1823, Colt, of revolver fame, took up the study of mines, and employed electric means of ignition. By this improvement he succeeded, on the 20th August 1824, in destroying a schooner anchored 5 miles off the shore; on the 18th October in the same year he sank a brig lying at anchor on the Potomac; and on the 13th April 1843 he destroyed

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a vessel *in motion* some 5 miles from the land. On these occasions observation mines were used, the right moment for firing being signalled to the shore on closure of the electric circuit by the contact between vessel and mine. As gutta-percha covered cores were unknown at that time, Colt used wires coated with a mixture of asphalt and beeswax. Perfect insulation was not obtained thereby, but it was sufficient for his purpose—to prevent metallic contact between the two submerged connecting wires.

"During the Schleswig-Holstein War of emancipation in 1848–51 the Keil Harbour was defended by electric observation mines, constructed and laid by Professor Himmly of Kiel University, and it was, no doubt, due to their presence that the Danish fleet hesitated to force an entry into that port. The Russians were the first to use a systematically planned mine-blockade for the defence of Kronstadt during the Crimean War. Two ships of the Allied fleets, the *Merlin* and the *Firefly*, got within the mined area, and the former vessel struck one of the mines, which exploded. Both vessels were seriously crippled, but remained afloat. These *contact-mines* have been erroneously attributed to Professor Jacobi. The real inventor was, however, Nobel, the father of Alfred Nobel, the famous inventor of dynamite; although it is probable that Professor Jacobi rendered valuable assistance in the construction of the fuses. The mines were fitted with chemical means of ignition, and were charged with gunpowder. The igniters consisted of glass tubes filled with sulphuric acid, and embedded in a mixture of chlorate of potassium and sugar, contained in an outer tube of stout lead. The closed end of the lead tube projected several inches outside the

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mine, so as to become bent on coming into contact with a passing vessel; this would cause the inner glass tube to break and the acid to flow into the mixture of chlorate and sugar. The resulting flame fired the gunpowder charge. *Electro-contact mines* were also used by the Russians during the same war, but, it would appear, with indifferent results.

"Up to that time contact-mines—*i.e.* mines which exploded automatically through impact—had been principally employed. They required a considerable buoyancy, especially when moored in strong currents, and thus constituted a certain danger and impediment to home shipping. In order to obviate this disadvantage, so-called *ground-mines* were introduced, which were laid on the sea-bottom and fired by observation at the moment a hostile vessel was found to pass over the spot. Owing to the explosive effect being reduced as the distance between the centre of the charge and the objective increases, these ground-mines involved the use of much larger quantities of explosive. Moreover, it was difficult to decide by observation whether a vessel was actually within the effective radius."

During the War of 1859 between France and Austria, Major Ebner of the Austrian Army made use of the *camera obscura* for determining the best moment for firing ground- and observation-mines. Inside a bomb-proof observation room on shore there was a table with a ground-glass plate showing a picture of the harbour. During the laying of the mines a reflected picture of the harbour was thrown through a lens and focused so as to coincide with the permanent picture, and the position of each single mine was marked on the latter. Under the table

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was a powerful battery and a commutator to which all cables from the mines were connected. The electric circuits had "earth" returns, and could be closed by separate contact-keys. The movements of a vessel appearing within the mine-field were, of course, projected on the table, and could thus be followed by the observer. When the picture of the vessel was seen to cover any of the points marking the position of a mine, the vessel itself was also passing over that mine, and by pressing down the particular contact-key the mine could then be exploded. This arrangement answers very well in bright daylight, but in foggy weather, in a smoke-laden atmosphere, or on dark nights, it is unsatisfactory.

It was not until the year 1862, during the American Civil War, that the submarine mine was for the first time extensively and successfully used. The Southern States, owing to their inferiority at sea, were obliged to remain on the defensive, and to defend their coasts against blockade and pillage. For such purposes nothing better than mines were available. In former wars there had always been expected a feeling that submarine mines would not be regarded as legitimate weapons in civilised warfare; under the stress of circumstances, however, the Southerners were compelled to disregard sentiment, and they ultimately decided to use mines wherever circumstances and prospects of success appeared to be favourable. The mines employed during this war were of various types, many of entirely new construction, such as frame and spar torpedoes, drifting and electric observation mines, the latter carrying charges up to one ton of gunpowder. Gutta-percha covered copper wires were used for electric connections.

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The Northern States, who had a comparatively powerful navy, lost through mines in this war against the Southern States, whose navy was but insignificant, a total of 22 warships, including 9 of their latest type of ironclads and monitors, whilst 4 other vessels were placed out of action, and a dockyard, with all the vessels it contained, was destroyed. When it is remembered that during the whole of this war the Southern States never once succeeded in sinking an enemy ship by means of their guns, the valuable services which the submarine mine—imperfect as it was in these days—rendered them must be recognised.

The Russo-Turkish War of 1877 should have offered excellent opportunities of applying the lessons of past experience gained in all methods of submarine warfare. The comparative strength of the belligerents was very similarly proportioned to that existing at the outbreak of the American Civil War. On the one side Russia, with an extensive coast-line, had only an insignificant Black Sea fleet to defend it with, and on the other Turkey possessed a navy which, at that time, was considered worthy of respect. But Turkey had done next to nothing in the way of mine defence, her only precautionary measures having been to close the Dardanelles by means of heavily charged observation mines. Russia, on the other hand, possessed a large number of electro-contact mines of German make, charged with gun cotton.

It was when crossing the Danube that the Russians scored the first success with their mines. So long as the Turkish warships patrolled this stream, it was hopeless for the Russians to attempt to bridge it. The destruction or incapacitation of those vessels,

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therefore, became indispensable. This, however, could not be accomplished by gun-fire alone, and it was therefore decided to effect a crossing under the protection of two rows of mines, one above and the other below the spot selected. The mine areas were covered by land batteries. Owing to the adoption of these defensive measures, the Turkish naval commanders were unable to prevent the bridging operations, and, later, the passage of the Russian Army. In this case the effect of the mines was purely moral, but such influence is frequently as decisive as their destructive effect.

On the 25th May 1877 the Russians successfully carried out a night attack on one of the Danube monitors by means of spar torpedoes electrically fired from steam-pinnaces. Although under fire, two of the pinnaces managed to get their charges home, and the vessel at once began to settle down, the crew continuing to fire from the sinking ship. The attacking parties escaped practically unhurt. The monitor in question was the *Seifi*, of 512 tons. During a reconnaissance at the mouth of the Sulina, the Turkish gunboat *Suna*, which, in company with another gunboat, the *Kartal*, was chasing Russian vessels, struck a contact-mine and sank immediately. If no further successes are to be placed to the credit of the Russian torpedo fleet in the course of the war, this must be ascribed to the supineness of the Turkish Navy, who made no energetic efforts to challenge the submarine tactics of their formidable enemy.

During the Franco-German War the rivers Elbe, Weser, and Ems were closed by contact-mines, but no attempt was made by the French warships to force an entry. The mines fulfilled their purpose, however,

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for their presence no doubt sufficed to keep the enemy away.

"The German Admiralty had by this time fully appreciated the importance of submarine mines, and soon after the war of 1870–71 steps were taken to create a special department for mine defence and improvements in mine construction, which, owing to the interest awakened through the important part played by the submarine mine in the Russo-Japanese War, soon attained a high degree of perfection."

The mines used in the war in the Far East showed a considerable advance on the old pattern, being fitted with electric contact-ignition and charged with high explosives. During this war, Russia lost the following ships through mines:

Petropavlosk, 1st class battleship, off Port Arthur on 13th April 1904.

Gremjaschtschi, coast-defence vessel, off Port Arthur on 18th August 1904.

A protected cruiser and two torpedo boats.

Although the Japanese remained masters of the sea, their losses through the enemy's mines were much heavier, comprising:

Yashima, 1st class battleship, off Port Arthur in May 1904.

Hatuse, 1st class battleship, off Port Arthur in May 1904.

Heyen, armoured gunboat, off Port Arthur in September 1904.

Saiyen, protected cruiser, off Port Arthur in November 1904.

Takasago, protected cruiser, off Port Arthur in December 1904.

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Miyako, unprotected cruiser, off Port Arthur in May 1905.

Kaimon, unprotected cruiser, off Port Arthur in July 1905.

Three torpedo boats.

This was the first naval war in which the submarine mine, in its modern form, appeared as an important and independent arm for open-sea use, although during the American Civil War—as has already been shown—many ships were sunk by it when in an imperfected state, in rivers and estuaries. This being the first occasion of its use on anything like a large and practical scale, there is little wonder that it was not employed to the best advantage by either side. In some cases there is reason to believe that several Japanese ships were accidentally sunk by Japanese mines. Nevertheless, so great was the destruction wrought by the submarine mine during the war in the Far East that the attention of all naval Powers was directed to improving this new arm.

It being at that time considered primarily a weapon of defence and not of attack, preparations for its extensive use in future warfare were almost exclusively confined to the smaller Powers with a defensive naval policy. The German Admiralty, however, foresaw the important part submarine mines could be made to play in all forms of naval warfare if due preparations were made beforehand; and, with the object of converting them into an *offensive* as well as a *defensive* weapon, created a special department with a large staff, whose sole duties were to make adequate preparation in time of peace for the wholesale laying of mines on the high seas in time of war. That submarine mines were confined to a defensive

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rôle by those articles of international law which made it illegal to lay them outside the three-mile limit did not deter the German naval authorities. They perfected the submarine mine-layer and immediately on the outbreak of the great European War commenced scattering their huge supplies of these automatic submarine weapons broadcast over the North Sea and Baltic. The secret branch of their naval mining service also arranged for mines to be surreptitiously laid in the Irish Sea, the Atlantic, and the English Channel —places where their presence would be least expected, and where they would consequently do the most damage. No notice as to the location or extent of the mine-fields sown was given by the German Government to neutrals, nor was sufficient time allowed for neutral shipping then on the high seas to get safely into port. This disregard of the regulations made by the International Convention at The Hague in 1907 caused the loss of many neutral ships. When sown the mine-fields were left without guard-ships, with the result that many broke loose and drifted over the North Sea. Danish vessels were blown up off their own coast, Dutch vessels suffered in territorial waters, and Norwegian and Swedish ships were sunk and their crews lost through the presence, in all parts of the North Sea, of mines which for some reason did not become inoperative on breaking loose from their moorings, and which were consequently yet another violation of international law.

It was in this callous way that Germany opened the naval war against England in August 1914. Submarines with specially constructed stern tubes were largely used for the laying of these mines. They were able to cross the North Sea despite the

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vigilance of hundreds of Allied surface patrol ships, lay their mines off the British coast, and to return to their bases for further supplies. In a week or two from the opening of hostilities the North Sea, Baltic, and Adriatic were strewn with hundreds of German and Austrian mines, and neutral as well as Allied shipping began to suffer heavily. The average loss among *neutrals* during the first few weeks was eight vessels per week, which was quickly reduced to four a week by the activities of the British mine-sweeping fleet, numbering over 2000 vessels. The loss of British ships at first averaged five a week, but was later reduced to two. The total loss of Allied warships and merchantmen from German, Austrian, and Turkish mines was approximately 500 vessels, 280 of which were lost in the North Sea and English Channel. The British Navy suffered less severely than was at first anticipated, owing to the drastic measures adopted and the large number of vessels available for sweeping operations. During the first month of this mine-warfare only three warships were sunk: two small cruisers, and one torpedo gunboat. Had it been necessary, however, for a British fleet to force a passage through these mine-fields at speed, in order to attack a German fleet operating behind them, or covering the landing of troops on the English east coast, there can be little doubt that the loss of warships would have been far greater.

This proves that for mines to be used *offensively* other than for the illegal purpose of destroying defenceless merchant shipping some necessity, or inducement, must be created for the fleet, against whom they are intended, to pass over them,

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otherwise they serve only the defensive rôle of creating temporary hydrographical barriers, which can be easily cleared away when they are left unguarded. Mines scattered indiscriminately over a theatre of war, and left to the tender mercies of wind and tide, soon break away from their moorings, and often become a serious menace to the fleet which laid them. It was in this way that the German Navy lost several small vessels in the Baltic and North Sea. Furthermore, such a mode of warfare defeats its own ends, because any navy resorting to it thereby proclaims its intention of remaining behind its shore fortifications and not venturing into the open sea, otherwise the risk it would run from its own scattered mines would be as great as that of the enemy. It may therefore be said with truth that scattered mines which shut an enemy out, if left untended for any length of time, also shuts a defending fleet in, and makes an action extremely hazardous for both sides.

The offensive use of the submarine mine can only be accomplished when there is a necessity or an inducement for the hostile fleet to pass over a given area of sea which is for a short time previously accessible to surface or submarine mine-layers. The degree of success which is likely to attend such operations depends upon two factors: (1) whether the place chosen for the mine-field is one likely to be suspected by the enemy, and (2) the secrecy and speed with which the mines can be laid. These conditions can be more frequently fulfilled by the use of *specially constructed submarines* of large size for laying the mines. An under-water craft which can sow mines anywhere, within 1000 miles of its base or floating depôt, and can avoid interception by hostile destroyers or cruiser

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patrols, or by the main fleet itself, on the voyage to and from the mine-area, is the best possible auxiliary for the conduct of offensive mine warfare; especially as it is necessary that the mines when laid should be closely watched by an invisible craft, which can not only attack any advance guard which may discover the presence of the field, or give the *coup de grâce* to any hostile vessel injured therein, but can, if international law is to be considered, also warn any neutral ship approaching the danger zone. This suggests the possibility of the submarine mine-layers being connected by electric cables to the mines themselves, which could then be made inoperative at will; and in this way the scouts and advance guards of a battle fleet could be allowed to pass unharmed over the mines, which, by the switching on of the electric current from the submarine, could then be made to explode on contact with the larger and more valuable vessels of the main fleet.

If destroyers are to be largely used for attacking submarines, then the under-water craft have an answer to this new menace in the offensive use of the mine by one or more vessels of each flotilla. Although destroyers are almost immune to torpedo attack, owing to their shallow draught, speed, and manœuvring abilities, they are exceptionally vulnerable to submarine mines, as their hulls are less able to stand the force of an explosion than those of any other class of warship, and their high speed, which gives them immunity from the torpedo, will frequently place them in a mine-field before they are aware of its presence. If, then, a mine-field is placed in a central position, and submarines are told off to manœuvre round this field until hostile destroyers are sighted,

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when they can rise to the surface with the field between themselves and the enemy, it is more than probable that the destroyers, knowing the rapidity with which submarines can dive below the surface and elude pursuit, will go at their quarry full speed ahead, and before they are even aware of its presence will find themselves entangled among the mines and suffer great loss. The provision of one or two rearguard submarines with a number of small mines, either of the floating, submerged drifting, or moored type, which could be laid while the vessels are travelling submerged, would enable an under-water flotilla, when attacked by surface craft, to sow them very effectively across the immediate line of advance of the attacking surface ships.

It may be thought that this would involve the loss of the submarines employed in laying the mines, owing to the reduction in their speed due to the conduct of the operation; against this, however, is the fact that the mines would be of small size and would be laid while travelling submerged, and the vessels so employed would be given extra-powerful engines in place of some of their torpedo or gun armament; they could sink deep the moment their work was accomplished. Moreover, it will be a cardinal point in submarine warfare that if, by the sacrifice of one or more vessels of a flotilla, greater damage in proportion can be done to the opposing surface fleet, then it is justified by the naval law of attrition. This solution should, however, only be accepted by submarine commanders, whose vessels have strategic and tactical advantages to enable them to outmanœuvre surface ships, when pressed by the exi-

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gencies of war, and when the loss of one or more of their vessels is not of vital concern in the general naval scheme.

The foregoing, which is by way of example only, shows one of the most effective ways of successfully employing the submarine mine for offensive warfare. Its defensive use lies in the systematic laying of mine-fields for blocking the entrance to harbours, the passage of straits and waterways, and the creation of artificial hydrographical features and barriers in given areas of sea which it is desired to close to the passage of hostile ships. An example of this kind of warfare was afforded by the British deep-laid mine-barriers across the Straits of Dover and the northern section of the North Sea. *Blockading mines* are sown by an investing squadron across the entrance to the harbour which it is blockading in order—(1) to check sorties by torpedo flotillas; (2) to prevent the running of the blockade by merchant ships; (3) to stop the emergence of the hostile fleet from the harbour without suffering an initial loss from the mines; and (4) to prevent the same fleet, if it elects to come out and fight, from making a sudden attempt to escape or of having an uninterrupted opportunity of deploying for battle, deep-laid mine-fields—mines moored about 60 feet below the surface—can be used to check the egress of submarine craft. Examples of the defensive use of submarine mines were afforded by the defence and attack of Port Arthur (1904–05); the defence of the German coast in 1914–15, and the laying of a British mine-field (artificial hydrographical barrier) in areas lat. 51° 15′ N. and 51° 40′ N., and long. 1° 35′ E. and 3° E., in October 1914. The reasons which induced the British naval authorities

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to establish this mine-area were described by the Secretary of the Admiralty as follows :

"The German policy of mine-laying, combined with their submarine activities, makes it necessary on military grounds for the Admiralty to adopt counter-measures. His Majesty's Government have therefore authorised a mine-laying policy in certain areas, and a system of mine-fields has been established and is being developed upon a considerable scale.

"In order to reduce risks to non-combatants, the Admiralty announce that it is dangerous henceforward for ships to cross the area between lat. 51° 15′ N. 51° 40′ N., and long. 1° 35′ E. and 3° E.

"In this connection it must be remembered that the southern limit of the German mine-field is lat. 52° N. Although these limits are assigned to the danger area, it must not be supposed that navigation is safe in any part of the southern waters of the North Sea.

"Instructions have been issued to His Majesty's ships to warn East-going vessels of the presence of this new mine-field.

"This British mine-field was laid in order to place an artificial hydrographical barrier between the German naval base at Heligoland and the Allied commercial and transport operations in the English Channel and South Atlantic."

The offensive use of mines, even in the ways indicated in this chapter, involve certain points of international law, as it now stands; but the gross violation by the Central Empires in the Great War of almost all the humane regulations agreed to by the representatives of all nations at The Hague, make it necessary for sea Powers, desiring to keep the laws

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there made, earnestly to consider if the time has not come when the laws of naval war should be drastically amended in the light of modern conditions, and that if they are to endure the strain of war and *national necessity* they should not be upheld by some more potent force than moral obligation and public opinion. It is to be presumed that this is the real object of the League of Nations. With regard to the danger to neutral ships from contact-mines discharged at random from submarines, these mines could quite easily be made to become inoperative after the lapse of a given time. In most cases as little as sixty minutes would be ample for the accomplishment of this object. This, of course, would not apply to moored mines guarded by submarines.

A point to be noted is that, although deep-laid mines are a distinct menace to submarines in shallow seas, no known system of mine defence can *alone* be relied upon to bar the passage of hostile submarines across the ocean. In very shallow water a series of mines moored one under the other is a good temporary defence, but its discovery will often destroy its efficiency, as the submarines have usually the choice of different routes, although this was not the case with the German flotillas enclosed in the North Sea alone. The repeated penetration of the Dardanelles afforded sufficient evidence of the truth of this statement.

What is now, and will in future naval warfare be, the effect of this remarkable development of the submarine mine it is difficult to determine, owing to the lack of finality in the evolution of weapons of war. Many new and wonderfully efficient mines are even now being evolved by several naval powers.

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That it will place new dangers and difficulties in the path of all surface ships is a foregone conclusion; that it will lessen the fighting value of the big battleship is also certain, because there will be a tendency to divide the losses inevitable over a greater number of units of collectively superior force; that it will be an ever-increasing danger to the cruiser, whose duties compel her to keep the seas and act as an advance guard and patrol, must also be accepted; and that destroyers will not enjoy the same immunity from the mine as they do from the torpedo, is a fact beyond question. The dangers to merchant ships in zones of war may be slightly increased, but not in proportion to the dangers they must face from the commerce-destroying submarine. There has also to be considered the possible perfection of defence measures, such as the Paravane, which affords some protection for moving ships against moored mines, and the "blister" already described. The mine and the submarine vessel are allies, which should do much to increase the value of both. This, however, does not prevent the former from being a danger to the latter in certain instances, and heavy losses must be expected. With mines strewn by under-water layers across the line of advance of hostile fleets to cause them to deviate from their course or to reduce speed while sweeping operations are being carried on, and submarines acting simultaneously on their flanks and rear, the operations of surface fleets will be beset with difficulties and dangers which will increase or diminish according to the skill, *or personal element*, of the submarine crews, which has been described by Admiral Sir R. H. S. Bacon, the father of the British flotillas, as the dominating factor in submarine warfare.

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PART VIII

THE INFLUENCE OF THE SUBMARINE ON THE NATIONAL LIFE OF MARITIME NATIONS

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I

SUBMARINES AND SEA POWER

WAR is not only a matter of fighting on land and sea, its ramifications stretch deep into the harbours of national life, changing the habits and customs of peoples. The weapons of war have long since ceased to be confined to scientific and mechanical destroyers of life; included in the armoury of the god of destruction are the more subtle weapons of "frightfulness," starvation, robbery, intrigue, national paralysis, panic, revolution, and the creation of all earthly hells. Against these *nations* must arm and fight, as do their ships and legions against those of the enemy. War is no longer confined to a test of the size, bravery, and skill of fleets and armies, but is the conflict of races, moral, mental, and physical.

Victory or defeat does not begin or end on the field of battle, neither does the influence of new weapons, devastating or revolutionising in their effect on the conduct and course of campaigns, confine itself to the actual theatre of war. Its reflex is felt in every branch of national life; and in agriculture, engineering, finance, and commerce, as in the domain of strategy and tactics, new combinations must be met by new dispositions. The aeroplane and the Zeppelin extinguished the lights of almost every town in England during the Great War; the submarine's influence is deeper

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rooted but less spectacular. Its economic influence on Great Britain is summed up in the words of Lord Selborne: "After the war the whole question of our agricultural and economic policy of the food production at home will have to be revised in the light of our *submarine experience.*" Its influence on each nation varies, but is none the less real because it strikes at the roots of production, the interchange of commodities, shipping, finance, and international law.

The following pages are intentionally suggestive only. They do not aim at the enhancement of the submarine as a weapon of war, or at its dethronement by international law, but are intended to serve only one purpose, that of unravelling and defining the influence of the submarine on national life in time of war, in order to awaken those who administer the empires of to-day and to-morrow to the need of provision against a new and growing menace which has changed the older theories of sea power.

Nations with vital interests on the sea cannot disregard the effect of modern submarine fighting on shipping and commerce because many submarines have been destroyed. Whether the loss by Germany and Austria of over 120 submarines and many thousands of mines was, or was not, justified by the sinking of about 600 merchant ships of over 300 tons, and some 50 warships, during 1914 to 1919, *is purely a naval question.* The Central Powers need not have employed their under-water craft in the eminently risky way they did. Had they confined their activities to attacking warships in the North Sea, Baltic, and Adriatic, and so avoided the dangers consequent on the long and frequent voyages round the British

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coast, their losses would, undoubtedly, have been far less. British submarines inflicted great damage on the commerce and transport operations of the enemy in the Baltic and the Sea of Marmora, but, notwithstanding the difficulty and danger of reaching these seas, their losses were by no means heavy, therefore any comparison between the loss of submarines and the destruction of shipping occasioned is more a question of their strategic use in *one* campaign than a test of their value in naval war. The conditions pertaining in one operation seldom occur in another. The fighting value of the submarine is proved beyond question by its ability to avoid superior surface force and deliver submerged or surprise attacks on both warships and merchantmen with favourable chances of success. This ensures for this type of warship a leading rôle in future naval warfare, and its effect on merchant shipping, whether immediate or moral, is one of the vital factors with which nations will have to reckon on plunging into the throes of conflict.

It has been shown that the superiority of a surface fleet, or the command of the sea, cannot be expected to prevent hostile submarine activities, and that one under-water fleet is almost useless as a protection against another. A fleet holding command of the surface increases the dangers and difficulties of hostile submarine operations and makes the losses which must be faced far greater, but it can only do this with greatly increased risk to its own units. This does not destroy though it may impair the value of a surface fleet, because the fundamental value of sea power lies in the command of the whole surface, as the great highway of commerce and intercourse

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between nearly all countries of the world. It seems ridiculous to say that the object of the submarine is the destruction of surface ships, and that without the latter the former would be a useless expense; but underlying this seemingly absurd statement is the fact that *sea power* includes not only warships but merchantmen, and not only merchantmen but naval bases, shipyards, and commercial harbours, without all four of which the sea power of a nation cannot last.

A nation which possesses few harbours is not likely to possess many merchant ships, and needs but a small fleet to guard its maritime interests in war. It may, and will if it is wise, possess a few submarines for coast defence; but a nation with a short coast-line and few harbours has, in almost all cases, long land frontiers, and the military necessity of adequately guarding these will entail a financial burden on the people of that country which makes the building and maintenance of a big navy, for which there is no real need, a political impossibility. Rather will a nation so placed seek by commercial and diplomatic means to ally itself with a big naval Power. A nation with a colonial empire and many harbours will surely have a large mercantile marine and an adequate navy, and when war is in progress between two such nations the commercial damage which the submarine flotillas of each can inflict on the other will be more or less equal according to geographical position, numbers, and strength of surface force. It may be thought that the nation with the greatest maritime commercial interests would suffer the most; but this should not be so, because the nation with the greatest interests on the sea will in all probability be superior not only in surface ships,

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but also in submarines and in skill and *morale*. In the days of the wooden walls, the loss of ships, both of commerce and war, was far greater in proportion than it is in modern fighting; and yet England maintained command of the sea. These and other considerations support the theory that a sea Power can suffer losses out of all proportion to the initial strength of her fleets, because the enemy will, if the skill is even, suffer equally while inflicting those losses, and because without *the means to make good such losses* she would never have held the trident of Neptune. In the abstract, then, the sea power of a nation cannot be estimated by ships only, but by the facilities on shore for their rapid construction; and the command of the sea cannot be wrested from a supreme navy and mercantile marine until its building resources are either destroyed or paralysed. In this connection the growth of hostile aerial forces must be closely watched and countered.

In all forms of modern warfare there is a primary objective, usually the capture of the political and economic base of the enemy. The German submarine operations of 1914–18 were directed against British shipping, food supply, and economic stability, regardless of the fact that a nation which could build, equip, and maintain a war fleet of about 3000 vessels in constant commission, and a mercantile marine of approximately 35,000 ships, would be easily able to make good any losses among this enormous fleet occasioned by 100 or 200 hostile submarines *without oversea bases*. If it had been directed, as it was at first, against the superiority of the British surface war-fleet over that of the German, then the same answer would have been given. The German naval

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authorities were faced with the problem :—which to attack with the main body of submarines—the navy or the mercantile marine of England, both vitals of the sea Empire. If the former was chosen as the main objective, then the damage likely to be inflicted on so large a fleet by so few submarines—considering the facilities possessed by Great Britain for the rapid construction of new units to replace those lost—would be insufficient to reduce the fighting power of the British Navy to a point at which it could, with any likelihood of success, be engaged in open fight by the German fleet. If, however, the mercantile marine and the oversea commerce of England was chosen as the main objective, not only would the effect of the German submarine war be immediately brought home to the people of the British Isles, but neutral ships would be afraid to enter the danger zone, and the absolute reliance of Great Britain on food supplies from overseas would cause such a rise in the price of necessities that the economic basis and stability of the country would be upset, and partial famine would be rapidly followed by revolution. In order to prevent this the British main fleets would be compelled to release their hold on German oversea commerce, and by keeping open the trade-routes to and from the American continent and the Far East be forced to recklessly expose their big ships to submarine attack. In this way did Germany hope to not only create a panic in England, but also to *rapidly* reduce the fighting power of her navy, so that the time would come when the carefully guarded and strengthened German fleet could leave the shelter of its land fortifications and meet the weakened fleets of England on a more or less equal basis.

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Analysing this plan we find in it the germ of correct submarine strategy rendered impossible of accomplishment by the few under-water ships available compared with the immense commercial and war fleets of England. The correctness of the strategic conception lies in the fact that for offensive warfare to be conducted by a submarine fleet against a superior surface fleet some necessity must be created to induce the surface fleet to expose itself to attack. This was attempted by the loudly-proclaimed threat against merchant shipping entering and leaving British waters. The failure was due to a series of factors detailed in a previous chapter. Had the three hundred millions sterling spent during recent years on the German fleet been used exclusively for the construction of submarines, there can be little doubt that the result would have been far more serious for England. The destruction wrought by the 150–200 vessels of this type employed during 1914–18 enables a fairly accurate estimate to be made of the effect on the shipping, food supply, and oversea trade generally of the British Isles had, say, one thousand hostile submarines (approximate cost, £200,000,000) been immediately available instead of one hundred and fifty.

In all considerations involving naval strategy one of the most important factors to be borne in mind is *time*. Whether or not the losses being inflicted during any given period on a fleet are becoming dangerous, must be judged in conjunction with the building capabilities during an equal period. In modern warfare when the ratio of loss to new construction is heavily on the increase, then strategy must find the way to gain time and yet hold the enemy.

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In aiding this manœuvre, or *vice versa*, submarines again come to the fore.

The dependence of Great Britain on her oversea commerce can be accurately gauged by the number of ships annually entering and clearing from her home ports; the average being 15,000 vessels of over 300 tons each, with a total displacement of 21,000,000 tons. Any estimate of what a stoppage of even a portion of this huge volume of sea-borne commerce would mean to the people of Great Britain must be made in conjunction with a review of the general agricultural and commercial condition.

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II

ECONOMIC EFFECTS OF SUBMARINE WARFARE ON MARITIME NATIONS

IN time of war a nation must expect to do without those luxuries to which it is entitled in times of peace. Any estimate of a people's need must therefore be based primarily on their dependence on supplies from overseas of food and ammunition. Of these two necessities the former presents a far greater problem than the latter, because stores of ammunition can be better accumulated in time of peace, and are of less bulk for transport during war. The food problem, so far at least as England is concerned, resolves itself into one of wheat, meat, dairy produce, and sugar. The dependence for these necessities on oversea supplies has hitherto been a dominant factor in all considerations of naval strategy. As to the exact extent that England was dependent on other nations for its necessary food supplies we have reliable figures to show that out of a total consumption of wheat, valued at £58,000,000 per annum, £48,000,000 worth was imported and only £10,000,000 worth grown at home. The value of the total consumption of meat was approximately £130,000,000 per annum, out of which only £52,000,000 worth was imported. Dairy produce—so important to child life—was annually imported to the value of £35,000,000,

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compared with a total consumption of just under £78,000,000. So little sugar was produced at home that practically the whole consumption, £26,000,000 per annum, was imported. Reckoning only these *vital necessities*, the total value hitherto imported averaged about £161,000,000 per annum.

The sudden stoppage of these supplies for even a short period would mean great discomfiture and a shortage of food for the people of Great Britain, but it is decidedly wrong to assume that actual starvation would be rampant. It would take many months of close and effective blockade to reduce the British Isles to a condition of complete starvation. Although only about one-fifth of the wheat consumed has been grown at home, the supplies of substitutes are very large (barley, oatmeal, and potatoes), and taken generally, for man does not live on bread alone, the United Kingdom produces about half the annual quantity of food consumed. Under pre-war conditions the most tense period would occur shortly after *an effective* blockade had been established — before adequate provision was made for the collection, transport, and equal division of all the food supplies of the country.

Although the generally accepted theory that England would starve if the supply of food from overseas was even temporarily held up is not borne out by those who have made careful studies of the problem, it is nevertheless patent that a great shortage of food would occur; and when the food of a people is brought below the margin of necessity there follows panic, riots, and general paralysis of the whole system of organised government. Had the German Navy in the Great War been composed of one thousand large and powerfully armed sub-

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marines with but few surface warships, the oversea food supplies of Great Britain would have been almost entirely cut off during the first few months of conflict, and the disposition of the fleets must have been changed to meet the civil rather than the naval requirements, and probable defeat and invasion would have been the result, *for Germany had left a section of the east coast free of mines for this purpose.* As it was, the "submarine experience," quoted by Lord Selborne, the Minister of Agriculture, as necessitating a complete revision of the economic policy as regards the food production at home after the war, should be a lesson to England that never again, through over-confidence or the belittling of new weapons or conditions, must the same terrible risks be run. A great London newspaper in August 1915 struck the right note when it told its million readers that—

"In a war of the future the submarine may be a much more perfect and deadly instrument. The type may grow into an almost indestructible under-water Dreadnought. Or an enemy might build hundreds where he had built tens. It is not mere fantasy to suppose that the Germans would not have hesitated to aim at building and manning a thousand submarines had they possessed as much naval genius as they did military prescience. The Kaiser would probably barter a good many of his monster ships for a score or two of submarines, delivered immediately!

"The plain lesson of Lord Selborne's speech and the scheme for increasing food production in Scotland is that the only way to win in war is to prepare for it in peace not only in guns but in the organisation

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of trades and agriculture. We must all recognise this as a fact and not as a platitude."

The total acreage under wheat in the British Isles during the year of national emergency 1915 was 2,000,000, and it has been calculated that in order to be self-supporting in this primary article of food no less than 20,000,000 acres are required (total area of United Kingdom, 77,683,084 acres). To devote this enormous area to wheat alone would be almost impossible, owing to the nature of the soil in many parts of the country, and, were it possible, would be detrimental to other valuable products of the soil. There is, however, no reason of soil or climate why the present acreage should not be enormously increased; and in order to make up the deficiency then existing between the home production and the home demand a naval fleet of large submarines capable of the dual rôle of supply-ships and mine-layers should be constructed and maintained with colonial assistance. The engineering difficulties pertaining to the construction of such ships have ceased to exist, and their cost would be less than that of commerce-protecting cruisers.

This, or some other such measure, is here advocated not because the loss of merchant ships in the earlier and more dangerous stages of the Great War was unduly heavy, but as a precaution for the future, when great and startling changes in the theory of sea and air power must be expected and provided for. Submarine carriers of about 5000 tons displacement would be of great naval and military, as well as *economic*, value. They could be used, if necessary, for the transport of troops through narrow seas difficult of access to surface ships, as supply and depôt ships for active submarine flotillas, and as submarine

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mine-layers. They would thus possess a sphere of utility peculiarly their own under almost every conceivable condition of naval warfare.

The direct effect of submarine warfare on the mercantile marine and commerce of a nation ultimately places a burden on its financial resources, both national and private. In order that merchant ships may keep the seas, the State must come to the aid of the owners and underwriters. If the losses of ships and cargoes are heavy, then it is the people, through their Government, who must bear that loss *in addition* to paying the increased prices for imported commodities due to the same disasters and to the increases in the rates of insurance. There has also to be reckoned the natural increase in the price of these commodities due to the wastage of supplies through wholesale loss at sea, and the unnatural increases due to neutral markets raising the prices artificially in view of the need of belligerents. In this way a quadruple financial burden is placed on a nation at war when the necessity exists for maintaining the full ebb and flow of oversea commerce, and is, in itself, without the menace of starvation, a sufficient inducement for every nation, where possible, to organise at least its agricultural and pastoral resources in time of peace, so as to provide a sufficiency of necessities in time of war.

The losses of shipping and cargo suffered by Great Britain during the first year of the Great War (1914) was approximately twice as heavy as that sustained during the preceding year of peace. In the first half of the second year (1915) the loss was heavier still, but it then began to slowly decline. The Liverpool Underwriters' Association estimated

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that, reckoning only the losses amounting to £10,000 and upwards, the total cost for 1914 was £13,688,954, as compared with £6,736,000 in 1913. These financial losses were caused by the destruction of 272 vessels (1914 ending 21st February). The total losses of the ships of all nations in this year were 323, of which 105 vessels were sunk by surface warships, submarines, and mines. In addition, 16 vessels were "missing." Of these totals 115 were British steamers and 11 were British sailing-ships. With regard to the rate of insurance for cargoes (Government Fund), at the outbreak of war five guineas per cent. was charged; this was reduced to two guineas per cent. after the first three months of warfare, "without injuring the solvency of the Fund." For hulls, as apart from cargoes, the insurance was also considerably reduced. The average loss of ships and cargoes during the first year of the war was just over 2 per cent.

That the losses to shipping were not far greater is due to five factors: (1) the overwhelming superiority of the British Navy confined the principal zone of war to the North Sea, Mediterranean, Eastern Atlantic, and Baltic; (2) it prevented mines, dangerous to the ships of all nations, from being laid on the world's trade-routes; (3) by the employment of about 1500 mine-sweepers it rapidly cleared the North Sea of German mines; (4) the paucity in the numbers of German submarines available for the war on the oversea commerce with Great Britain enabled the British Navy by the provision of some 2000 armed patrols to reduce them at a rate which could not be equalled by the training of fresh crews and the output of new vessels from the shipyards of Germany; and (5) the naval superiority of the Allies *at once*

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ensured the command of the sea and prevented the dislocation and loss of international shipping by the danger of a number of zones of war.

On land, war may spread like the plague in spite of the presence of erstwhile all-powerful armies, but on the sea, such are the restricting influences that it cannot spread in the presence of an all-powerful fleet. This is an old axiom of sea power which the submarine has changed. With its power to evade superior surface force it has conferred on inferior navies so constructed the ability to elude an enemy and operate in any zone. In future naval warfare, no matter how powerful or well-manœuvred is the superior surface fleet, it will be unable to encircle and confine the activities of its submarine rival. Neither will the fleet of any nation be able to protect its oversea commerce if, by international law, this is open to destruction by hostile submarines. What effect these new conditions will have on the financial resources of nations at war it is difficult yet to accurately forecast, but the menace is sufficient to engage the attention of all serious statesmen.

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III

SOME INTERNATIONAL PROBLEMS

MANY and complex are the questions of international law raised by the employment of submarines and mines on the grand scale in modern naval warfare. A few of the more important problems awaiting solution are: (1) the question of the right of submarines to sink the unarmed merchant ships of an enemy on the high seas with or without warning, and due provision for the safety of the passengers and crew, when the submarines are operating in zones where it is impossible for them to effect the capture of such merchantmen by taking them into port; (2) the use of neutral flags by belligerent merchant ships to avoid capture or destruction by hostile surface ships or submarines; (3) the status of merchantmen armed for *defence* and *offence*; (4) the legality of the bombardment of seacoast towns by submarines when mine-fields have been laid in the offing; (5) the problem of submerged operations in neutral waters; and (6) the laying of submarine mines on the high seas outside the three-mile limit without issuing due warning to neutral ships either by disclosing the locality of the fields laid or by permanently guarding them.

The repeated and callous violation of so many of the rules of war agreed upon by the representatives

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of all civilised nations at The Hague, and subsequently ratified by their respective governments, prompts inquiry as to what is the foundation of international law. It is a truism that all law must rest on force, but there is *brute* force and *moral* force. The objects of international law are plain: they aim at the recognition of the greater laws of humanity and civilisation, and the limitation of the evil effects of war to combatants; but the foundations upon which these wise laws rest are far more obscure and complex. In *theory* they rest upon *international public opinion*, or moral force, but in practice public opinion is insufficient to prevent their violation with impunity by large and powerful nations, the correction of whom by any combination of other powers would entail the expenditure of much blood and gold. Thus in fundamental principle they are laws without equity, because their infringement by a great power is not met by the united opposition, both moral and physical, of *all* other civilised nations regardless of purely national interests; and, in simple phraseology, they bind small nations more closely than they do large and powerful ones. It should be the object of the League of Nations to change the basis upon which international law has hitherto rested. If it is to be a feared law—and no other will avail in times of national emergency—then it must rest on force—the employment of which it openly seeks to avert—or conjoint economic action, which is often a double-edged sword. Whichever is chosen must be employed in every case of wilful violation.

There are few of the humane rules of warfare as laid down which were not grossly violated by Germany during the great European War, and yet allies joined

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her standard for supposed national reasons after these violations had been made known and verified by the remainder of the entire civilised world; and neutrals raised but a feeble and ineffectual voice of protest. An admirable illustration of the insecure foundation upon which international law now rests is given in *Heresies of Sea Power*, by the late Mr. Fred T. Jane: "If the United States fleet, for instance, outraged international law in war, public opinion in the United States would be with the fleet and not with the law. Similarly, opinion in England—assuming that sympathy with the United States, which would exist in almost any war in which America might be engaged—would be a considerably more powerful factor than any regard for the letter of the law. Throughout the world generally only those nations which were anti-American to commence with would possess a public opinion at all in favour of the enforcement of the law. It would, in fine, be simply a vehicle for the expression of self-interest."

There are, however, branches of international law which will ever receive that vast measure of international public support required to enforce their observance. These may be regarded as those rules regulating the observance of the doctrine of humanity; and it would be well for the civilisation of the future if any branch of these, such as the German atrocities in Belgium, Poland, and Serbia, and the Turkish massacre of the Armenians, was met with an irresistible storm of protest from friend and foe alike.

Returning to the immediate purpose of this chapter—the problems of international law raised by the advent of the submarine in naval war—the

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conclusion first to be arrived at is that whatever laws may be made to regulate the employment of submarine arms no absolute reliance must be placed on them by naval powers. That any laws so made must be adhered to is the moral obligation of every signatory power; but that breaches will occur under military necessity is the lesson of history. The only limitation on the use and employment of weapons of war upon which absolute reliance can be placed is the mechanical and physical limitations placed by nature.

The question as to whether a submarine has the right to sink the unarmed merchant ships of an enemy depends upon many factors. Apart from any humane considerations it can scarcely be contended that a submarine ever possesses the moral right to destroy an unarmed merchant ship, and with it the lives of non-combatants, unless the surface ship has forfeited its right to be considered as an unarmed merchantman by acts such as the laying of hostile mines, or is engaged on naval and not purely mercantile duties. The right of submarines to sink the unarmed merchantmen of an enemy after due warning has been given and provision allowed for the safety of the passengers and crew is the real problem to be solved by international law. It appears to depend in a great measure on a number of factors. Where the practicability exists—from a naval point of view—of effecting the *capture* of such merchantmen by taking them into port, to sink them instead would be both unwise and unwarrantable, but when submarines are operating in zones where such procedure is not possible the destruction of prizes might be resorted to if they were carrying contraband, or attempting to run a blockade, provided due provision

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was allowed for the safety of the passengers and crew. The exact definition of what constitutes *due provision for the safety of passengers and crew* is another international problem. It can apparently only be held to mean the transference of themselves and their personal effects into the ship's boats with a supply of water, provisions, and a few medical stores, provided either from the stores of the doomed merchant ship or those of the attacking submarine. What is to be done if the sea is too rough for the launching of the ship's boats, if their size and number is inadequate, or if the ship is in the open sea and far distant from any hospitable coast, are problems of great difficulty. The same may also be said of the position of the submarine when a hostile merchantman refuses to stop when challenged. Any delay in an attack by an under-water warship on a fast merchantman may, and probably would, mean the loss of the opportunity. For this reason it is essential, from the point of view of the submarine, that instant compliance with the order to stop should be enjoined by international law on the merchantman who wishes to avoid being fired on. But when the position of the submarine is unfavourable for attack, such as dead astern, when the signal to stop is made, it is scarcely likely that the merchantman with a valuable cargo on board would comply with the order, and the submarine, by proclaiming its presence, would have destroyed any chance it might have had of a successful attack. The same difficulty presents itself in many positions when the speed of the surface ship is superior to that of the submarine. The provision of heavy naval guns in submarines will, however, greatly minimise this and other difficulties, by giving them the necessary range

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to prevent evasion by surface ships. In such cases the use of torpedoes against unarmed merchant ships is unjustifiable; but even this raises a problem, How is the commander of a submarine to know at sight what is and what is not an *armed* merchantman? Such will be the difficulty, that if he brings his ship to the surface the guns of the merchantman may destroy his vessel, and if he delivers a submerged attack with the torpedo, then the merchantman may turn out to be unarmed, and a breach of international law will have been committed, involving severe censure.

Yet another problem which confronts the framing of any laws for the conduct of submarine warfare arises out of the ramming tactics resorted to by merchantmen in the Great War. If a submarine makes known its close proximity and exact position by signalling the order to stop, then it must chance an attempt at ramming by the surface ship. Again, before it is possible to ascertain whether a vessel is carrying contraband or not, a search-party must be sent on board, and treachery of various kinds must be risked.

We now come to the use of neutral flags by merchant ships in order to avoid search, capture, or destruction by hostile submarines. This is a very old *ruse de guerre*, which can sometimes be more or less justified by the presence on board the threatened ship of a number of passengers, or a quantity of cargo, belonging to the neutral country whose flag is temporarily hoisted; but for international law to admit this principle would cause chaos. An extract from a memorandum on this subject, issued by the United States Government in February 1915, gives an excellent idea of the neutral flag difficulty.

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"The occasional use of the flag of a neutral or an enemy under the stress of immediate pursuit, and to deceive an approaching enemy, which appears by Press reports to be the precedent for the justification used to support this action, seems to this Government a very different thing from the explicit sanction by a belligerent government for its merchant ships generally to fly the flag of a neutral power within certain portions of the high seas which, it is presumed, will be frequented by hostile warships. A formal declaration of such a policy for the general misuse of a neutral's flag jeopardises the vessels of a neutral visiting those waters in a peculiar degree by raising the presumption that they are of belligerent nationality, regardless of the flag which they may carry."

Yet is it possible for any nation to prevent its merchantmen from hoisting neutral flags to save their ships and their cargoes from capture or destruction, and themselves from being turned adrift in small boats on the open sea?

The status of merchantmen armed for *defence* and *offence* next demands attention. It is generally admitted that international law gives to merchant ships the right to arm in their own defence, but when armed and employed for offensive action they become warships. It is difficult to conceive how submarine commanders can be expected to differentiate between one and the other. An extract from an article by the *Times* naval correspondent is of interest on this point.[1]

"Shortly after war was declared, it appears, Germany complained to the United States of the presence of 6-inch guns on board British merchantmen, which she held rendered them warships, and it was

[1] *Times*, 26th September 1914.

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reported from Washington on 5th September that instructions had been received by the British ambassador that our merchant ships plying to America must not carry guns. This step was evidently taken to prevent embarrassing the United States, which Power has since decided that a belligerent's merchant vessels may carry armament and ammunition for defence without acquiring the character of warships. It is laid down that the guns must not be larger than 6 inches, and none must be mounted forward. Should there be any British vessels which do not conform to the latter requirement, no doubt their guns will be removed to the stern. It does not seem likely that any have been armed with guns above 6-inch calibre. The practice of Great Britain in the matter is therefore completely justified.

"The status of the other class of merchant vessels equipped with guns is easily defined. They are warships in all respects, and subject to the same regulations as the ordinary vessels of the fleet into which they have been incorporated."

It will be noted that international law requires merchantmen arming in their own defence not to carry guns above the 6-inch calibre, and even these must be carried in the stern. While in many respects this limitation of size and mounting prevents offensive action against surface ships it does but little to curtail their offensive power against submarines, because the 6-inch gun is amply sufficient, both in range and explosive charge, to attack under-water craft of *all* kinds.

If the commander of a submarine is to be expected to differentiate between an armed merchantman engaged in legitimate commerce and one whose policy

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is attack, then some distinct and noticeable difference must be devised. For it can scarcely be expected that a submarine will expose itself on the surface within range of a vessel whose intentions and armament are doubtful.

With regard to the treatment of the crews of merchant ships which resist submarine attack, international law expressly states (*vide* U.S. Naval Code, article 10) that "the personnel of merchant vessels of an enemy, who, in self-defence and in protection of the vessel placed in their charge, resist an attack, are entitled, if captured, to the status of prisoners of war."

Another problem to be faced by international jurists is the question of whether or not the laying of submerged mines, *as a portion of a general naval scheme*, off an otherwise undefended coast town prevents that town from claiming immunity from bombardment; and whether submarines are entitled to bombard any town in which troops are quartered or in which munitions of war are being manufactured.

Although submarines are not allowed to lie in neutral waters awaiting the approach of victims, the impossibility of preventing under-water craft from entering neutral zones when submerged makes this rule practically inoperative, for there are few commanders who would not avail themselves of this expedient in unwatched neutral waters were it necessary for successful attack.

Finally, there is the international regulation prohibiting the laying of mines outside the three-mile limit, which, as the late Mr. Fred T. Jane has pointed out in *Heresies of Sea Power*, is almost a direct incentive to laying them farther out to sea, where they might be less expected. A mine laid where the enemy expects

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to find one is a perfectly useless weapon. The truth of this statement has been proved by the German methods in recent mine-laying operations. The same applies to the sowing of a mine-field in the open sea, the exact location of which must be advertised as a warning to neutral ships. A mine-field made known in this way ceases to have any offensive value, and becomes merely an artificial hydrographical barrier which can soon be cleared away by a powerful enemy, unless it is guarded by surface or submarine warships.

The international questions raised by the perfection and employment of submarine arms might be extended almost indefinitely, but the foregoing are the problems of complexity, exact definition of which is most needed by naval powers.

In the great European War many international regulations have been defied in the face of military necessity, and others without that necessity. The same result may, and probably will, occur in future warfare, but in order that neutrals and non-combatants may suffer as little as possible from these world catastrophes a clear international guide, supported by firm, international action, is needed.

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